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The purpose of this thesis is to provide a unit cost comparative analysis of electricity and water utility services between Navy Public Works Center San Francisco Bay and three local non Department of Defense public and private enterprises. The research focused primarily on procurement costs and the direct costs of distribution for fiscal years 89, 90, and 91. The latter costs include direct labor, direct material, and contract costs associated with preventative maintenance, repairs, and capital improvements. A review of the Navy's facility management strategy, the historical perspective of Navy facilities management, and the impact of Defense Management Review Decisions 967 (consolidation) and 971 (Defense Business Operating Fund) on Public Works Center San Francisco Bay is also provided. The research is conclusive in comparing procurement costs. While the Navy's water procurement costs were favorable, its electrical procurement costs were found to be 10% to 35% higher on a unit cost basis than the other sites. Electrical and water distribution costs for the Navy were very high in comparison to the other sites, but a number of factors exist which prevent any conclusive findings regarding the Navy's efficiency.

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Utilities Cost Comparison Analysis Between a Public Work Center and the Non-DoD Sector

by

David W. Danner
Lieutenant Commander, United States Navy Reserve
B.S., Trenton State College, 1976

and

David A. Berchtold
Lieutenant, United States Navy
B.S., United States Naval Academy, 1985

Submitted in partial fulfillment of the requirements for the degree of

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December 1992

ABSTRACT

The purpose of this thesis is to provide a unit cost comparative analysis of electricity and water utility services between Navy Public Works Center San Francisco Bay and three local non Department of Defense public and private enterprises. The research focused primarily on procurement costs and the direct costs of distribution for fiscal years 89, 90, and 91. The latter costs include direct labor, direct material, and contract costs associated with preventative maintenance, repairs, and capital improvements. A review of the Navy's facility management strategy, the historical perspective of Navy facilities management, and the impact of Defense Management Review Decisions 967 (consolidation) and 971 (Defense Business Operating Fund) on Public Works Center San Francisco Bay is also provided. The research is conclusive in comparing procurement costs. While the Navy's water procurement costs were favorable, its electrical procurement costs were found to be 10% to 35% higher on a unit cost basis than the other sites. Electrical and water distribution costs for the Navy were very high in comparison to the other sites, but a number of factors exist which prevent any conclusive findings regarding the Navy's efficiency.

TABLE OF CONTENTS

I. INTRODUCTION

Public Works Center San Francisco Bay (PWCSB) is a Navy public works service organization in Oakland, California, providing a wide range of base engineering services to Department of Defense (DoD) customers in the San Francisco Bay area. These base engineering services include providing utility services to its customers; namely, procuring and then distributing utilities over DoD utility distribution systems. PWCSB incurs two types of costs in providing utility services— procurement costs and distribution costs. Procurement costs are the direct purchase costs of obtaining utilities from a supplier, usually a private utility company. Distribution costs are preventative maintenance, repair, and capital improvement costs made to utility distribution systems. The utility distribution systems which PWCSB uses to distribute utilities are those located on various DoD installations in the San Francisco Bay area. A utility distribution system is the network of lines between where a utility enters the property of a an installation (or other connection point in which the property owner assumes responsibility for maintenance) and where it enters facilities or structures. PWCSB is responsible for the maintenance of distribution systems on its customer's DoD installations.

PWCSB desired a study that compared their cost of procuring and distributing a utility to the same utility costs in the local non-Department of Defense (non-DoD) sector to determine if PWCSB's rates were competitive with that sector. Furthermore, PWCSB recoups their procurement and distribution costs by charging their DoD customers a Predetermined Rate, a standard unit

cost rate, determined annually through PWCSB's budgeting process. PWCSB believed that their budgeting techniques needed to be reviewed and contrasted with those in the non-DoD sector to determine if more advanced techniques were being used that could result in better pricing.

A. THESIS OBJECTIVE

This thesis research is a unit cost comparative analysis of the direct costs of procuring and distributing electricity and water between Alameda Naval Air Station (NAS), one of PWCSB's major customers, and three non-DoD public and private sites of comparable interest in the local San Francisco Bay area. The primary objective of this thesis research is to provide PWCSB with an indication of how their electrical and water procurement and distribution costs for NAS compare with those of Site 1 in Table 1 below. Concerning utility cost comparisons, Site 1 is a non-DoD public enterprise that is of comparable interest to PWCSB. Table 1 displays the site data that was collected and used for the unit cost comparative analysis for not only NAS and Site 1, but also the other two sites participating in the research.

TABLE 1

SITE DATA COLLECTION

ENTITY	ELECTRICAL		WATER	
	Procurement	Distribution	Procurement	Distribution
NAS Alameda (PWCSB)	Yes	Yes	Yes	Yes
Site 1: Non DoD (Public)	Yes	Yes	Yes	Yes
Site 2: Non DoD (Private)	Yes	Partial	Yes	Partial
Site 3: Non DoD (Private)	Yes	Partial	No	No

This thesis research will assist PWCSB in determining if its electrical and water utility costs are competitive with the local non-DoD sector. Whereas the

unit cost comparative analysis was designed to compare procurement and distribution data for electricity and water for fiscal years (FYs) 1989 (89), 1990 (90), and 1991 (91); the years actually used for comparison vary because of limitations in the data collected at non-DoD sites. The non-DoD sites purposely remain unidentified, except to PWCSB and the researchers, to protect their identity. The development of the research topic and thesis objective is discussed next in the following four paragraphs.

B. FORMULATION OF RESEARCH TOPIC

The research topic originated from a 1992 Summer meeting with the outgoing PWCSB Production Officer. In PWCSB's attempts to reduce costs, management had historically focused on overhead and indirect costs. Customer complaints concerning the cost of services often addressed these costs. Because they frequently had been the focus of cost reduction efforts, overhead and indirect costs were believed by some PWCSB management to be at the lowest levels possible. Management identified overhead and indirect costs as the "tip of an iceberg" having been chipped at for years. Direct costs were identified as receiving little attention though in cost reduction efforts. Gains in efficiencies through work process improvements were believed to have potential to yield far greater cost reductions than efforts to further reduce overhead and indirect costs. Direct costs were described as the base of the iceberg comprising the bulk of utility costs but concealed from management. PWCSB also expressed an inability to forecast utility distribution costs and a desire to compare their budgeting techniques with other non-DoD entities, particularly utility companies that were believed to have sophisticated budgeting techniques different than the techniques used at PWCSB.

The researchers choose this topic because it provided the opportunity for substantial cost awareness and efficiency gains for PWCSB. While studies of this nature have been performed between electric companies, research comparing utility procurement and distribution costs for utility users could not be found. The potential for large monetary savings and the venture into new research requiring partnerships with regional public and private enterprises was perceived as interesting, challenging, and evolutionary and the reasons for selecting the research topic.

The Navy Public Works Centers (PWCs) in the continental United States and Pearl Harbor were contacted to determine if a Navy wide interest in the research was deemed beneficial. Overwhelmingly the PWCs expressed a benefit in the research indicating their staffs could also support it. Interest was particularly keen in discovery of algorithms that might be used by utility companies for budgeting purposes and in discovery of easier and quicker budgeting and rate setting techniques. Comparison of utility procurement and distribution costs between PWCs was not deemed beneficial because of regional differences attributing to cost differences and the centralized rate making process which sets rates at an authority above the PWC level.

The Naval Facilities Engineering Command (NAVFAC) avoided funding requests to permit a nationwide research effort. PWCSB therefore became the sole PWC of study. Analyzing budgeting techniques became a subsidiary question after funding was not available to permit travel to multiple utility companies nationwide. Budgeting technique comparisons were subsequently made using only the participating three non-DoD sites, none of which are utility

companies. Other subsidiary questions were formulated. Section C below presents the questions this research initially attempted to answer.

C. RESEARCH QUESTIONS

The research attempts to answer one primary question: Has PWCSB's costs to procure and distribute electricity and water been "competitive" with the local non-DoD sector? The research is important because PWCSB has no resources or gauging capability to compare its costs to the non-DoD sector in the local area. Although PWCSB does not compete with the local non-DoD sector directly, failing to be competitive puts pressure on PWCSB to improve its cost of services. If PWCSB is not competitive with the local private and public sectors, its DoD customers may demand access to private market services as an alternative to PWCSB. Presently, Navy policy requires Navy customers to use PWC services.

In a downsizing environment, PWCSB searches for ways to gain efficiencies to continue to provide high quality service at a reasonable cost. The comparison to the local non-DoD sector will aid PWCSB in determining its market position in the local economy. As data collection permitted, the following six subsidiary questions were to be addressed:

- How does the PWCSB's procurement costs of electricity and water compare to procurement costs of the same utilities in the local non-DoD sector on a unit cost basis?

- How do PWCSB's distribution costs of electrical and water distribution systems compare with the same in the local non-DoD sector on a unit cost basis?

- How does PWCSB's preventative maintenance of the electrical and water distribution systems compare with preventative maintenance in the local non-DoD sector on a unit cost basis?

- How does PWCSB budget for utility procurement and distribution costs and how does it compare to the processes used in the local non-DoD sector? Can a better system for PWCSB's predetermined rate determination be suggested?

- How does PWCSB's overhead and indirect costs compare with the same in the local non-DoD sector?

- What are the cost benefits to PWCSB from generating electricity instead of procuring it?

Of the six subsidiary questions, only the first two could be answered completely. Inadequate data prevented a complete analysis of the remaining questions. Inadequate data resulted from an inability to collect requested data or the lack of accounting systems to collect costs that were necessary. Chapter VI will address these questions to the extent data permits. Because the questions are broad in nature and resources were limited, limitations were imposed on the research. These limitations are addressed next.

D. RESEARCH SCOPE LIMITATIONS

Because of the resources available, the designed research was limited in a number of ways. First, the number of researchable utilities was limited. PWCSB identified electricity as their major utility of concern, so it was the primary utility of focus for the research. Data collection on greater than two utilities was not possible in the time frame allowed for thesis field visits.

Second, the research analyzed only one of the many electrical and water distribution systems maintained by PWCSB. The system at NAS Alameda was chosen because it is the largest user of utilities among PWCSB's customers and is the most representative to the other sites participating in the research, particularly Site 1. Additionally the residing Naval Aviation Depot (NADEP), the

largest utility consumer at NAS, and PWCSB have established a partnership in aggressively seeking cost reduction of utility services in which this research could be of potential benefit.

Third, the number of non-DoD participants was limited to three. Five different sites were asked to participate, but three were selected for various reasons. Because Site 1 was of particular interest to PWCSB, its inclusion in the study was a major objective. The non-DoD sites that participated in the study were relatively receptive to the research and to future networking, but other non-DoD sites were less enthusiastic and declined participation. The criteria used for site selection is provided in Chapter II.

Fourth, the research focus was on procurement and distribution direct costs; although, comparison of overhead and indirect costs was a secondary objective. The preceding discussion on the formulation of research indicates PWCSB's changing focus from overhead and indirect costs to direct costs. Indirect cost comparisons were expected to be difficult to make in this research because of the different types of organizations reviewed.

Fifth, the period of time was limited to the three most current years that data was available from PWCSB. Data collection occurred in the last quarter of FY 92 thereby limiting the three year period to FY 89, 90, and 91.

Sixth, the research did not analyze work procedures and processes that could explain the cost data. Instead site managers are expected to use their results internally or externally by networking further to analyze why their costs might be lower or higher than other sites. This limitation was a result of the focus of the research and the intentions of how this research would be used. This focus is developed next in Paragraph E.

E. FOCUS OF THESIS RESEARCH

This thesis research is intended to be used internally by PWCSB management and Process Improvement or Process Action Teams (PIT/PAT) to identify areas for further internal review that could increase efficiencies and reduce direct costs. The study is intended to assist internal managerial decisions for changing processes and procedures by supplementing PWCSB's application of Total Quality Leadership/Total Quality Management (TQL/TQM) techniques. The research is not intended to be useful to other PWCs because of the regional and economic differences between PWCs. The general approach could however be used by other PWCs to evaluate their own situation.

The study provides unit cost data to PWCSB that could aid managerial decisions concerning accounting, budgeting, cost allocation, cost control, and maintenance. Trend analysis that is currently not performed by PWCSB is also provided and usually is accompanied with limited observations and recommendations in the appendix. Because analyzing operational processes and procedures was beyond the scope of this thesis research, analysis of unit cost results are not followed with reviews of processes and procedures that could result in greater efficiencies. Management is better suited to perform these reviews of operations.

The research conducted will not alone result in immediate cost reductions nor will it provide quick and easy answers for PWCSB managers. The research will provide data not currently available that could be used to make PWCSB more competitive with the local non-DoD private and public sectors. This research is one step toward improvement. To gain the most benefit from this study, PWCSB should network further with the non-DoD participating sites to identify causal

factors of differing costs. The potential for networking benefits is presented in the next two sections.

F. PARTNERSHIP WITH INDUSTRY

Cooperation was gained from non-DoD sites who participated in the study. PWCSB can expect to network with them to progress into cooperative efforts that might be evolutionary in the Navy utility business. Continued partnerships by all participants of the study will be required for the research's full benefit to be derived. The partnership of PWCSB and the non-DoD local sector in this study is consistent with strategies envisioned by NAVFAC and the Department of the Navy (DoN). The research— although limited by data availability, time, number of sites researched, and accounting systems— provides one of a kind data that is unique to all the participants. The intent is that PWCSB will benefit not only from the comparable unit cost analysis and trend analysis provided, but will also benefit from the establishment of cooperative relationships with local industry.

G. BENCHMARKING

This unit cost comparison is being called "benchmarking" at PWCSB following the successes of similar work by private industry. The participants of studies similar to this one in the private sector would gather data from each of the participants and compare results. The lowest cost operator or provider was further researched and investigated by the group to determine the reasons for their lower cost of service or operations. The other group members then would make necessary internal changes to emulate the top performer. This study provides the first step of that process. The participants of the study should continue the partnership effort if the full effect of any benefit is to be achieved.

In the academic environment, benchmarking takes on another meaning. Specifically benchmarking means comparing data to a baseline year as PWCSB currently does with utility commodities' operation and maintenance costs. This thesis is consistent with the academic environment by avoiding use of the term benchmarking and more appropriately providing a unit cost comparison.

H. PREVIEW OF CHAPTERS

Chapters II and III provide background and methodology. Management from PWCSB will find these chapters of limited use and may desire to focus on Chapters IV, V, and VI. However, the end of Chapter II does provide an introduction to all sites that is recommended for reading. An outline of the remaining chapters is provided below.

1. Chapter II. Background and History

This chapter first explores the fiscal environment and the strategies that have been developed to meet the challenges of the future. A historical perspective of Navy facilities management is presented to provide the reader an understanding of the creation and organization of PWCs, their budgeting process, and the impacts of recent Defense Management Review Decisions (DMRDs) on PWCSB operations. The chapter is concluded with background on PWCSB, NAS, and the three non-DoD sites.

2. Chapter III. Methodology, Definitions, and Concepts

This chapter begins by stating the criteria for site selection. A discussion on unit costing and cost terminology used in this thesis is provided. The research methods used for the research concludes the chapter.

3. Chapter IV. Analysis of NAS Alameda Data

This chapter provides the unit costs for procuring and distributing electricity and water at NAS Alameda. Procurement and distribution costs are broken into cost components so PWCSB can easily make comparisons and identify cost drivers. Trend analysis and recommendations are provided in the appendixes so that they can stand alone and be easily separated from the thesis for internal PWCSB distribution.

4. Chapter V. Non-DoD Site Data and NAS Comparison

This chapter provides the unit costs for procuring and distributing electricity and water at each of the non-DoD sites. These costs are then compared to those of NAS provided in Chapter IV.

5. Chapter VI. Unit Cost Comparison

This chapter provides all unit costs obtained from the research after assumptions, comparability factors, and data limitations. The chapter concludes with a presentation of answers to the research questions to the extent data permits.

6. Chapter VII. Summary and Future Research Areas

This chapter reviews the research's results followed by recommendations for future research.

II. BACKGROUND AND HISTORY

The previous chapter stated the objective, focus, and intentions of the this thesis research. This chapter will first discuss the fiscal environment, its outlook, and the Navy's strategy to meet the challenges for the future. The discussion focuses on Navy facilities management. A background is provided on the development of PWCs and their role in Navy facilities management. The background is provided historically so as to understand how the Navy's PWCs became the DoD role model in the late 80s and early 90s. The PWC budgeting process and the impact of the Defense Business Operating Fund (DBOF) is also discussed. The chapter concludes providing background on PWCSB, NAS Alameda (NAS), and the three non-DoD sites participating in the research. This chapter provides all necessary background to understand how PWCSB fits into the Navy's facilities management organization, how Defense Management Review Decisions 967 and 971 impact its operations, and how NAS compares to the three non-DoD sites (by infrastructure, distribution system, and utility procurement source).

A. DECLINING FISCAL RESOURCES IN DOD

The DoD has experienced a substantial decline in fiscal resources over the last eight years. The DoD buildup under the Reagan administration ended in 1984. The change in the political structure of Russia and former Communist countries, Russia's lack of economic capability, and the removal of Russian troops from Eastern Europe ended the Cold War era and led to a perceived decline in military threats among much of the public and Congressional

politicians. Congress as well as the President have been quick to align fiscal resources differently than in the early and mid 1980s by budgeting and appropriating smaller defense budgets. President Bush agreed in May 1990 to cut the DoD force structure by 25% over a five year period. The final FY 91 budget provided real growth of minus 8% in FY 91, minus 3% in FY 92, and minus 4% in FY 93. [Ref. 1: pp.xx-xxi]

Continued downsizing and a smaller force structure is advocated by Congress, and the president elect has vowed for even greater defense cuts. Given the new world order and the growing public concern for the national debt, the DoD's budget is likely to decrease and be subjected to increasing scrutiny. Unless political objectives change or the United States is directly threatened, a fiscally constrained environment appears to be the norm in the short term if not also the longer term. The downsizing environment will continue to bear pressure on Navy service organizations for increased efficiencies while providing quality service. The DoD's reaction to current fiscal constraints is reviewed in the next two sections.

B. AN OVERVIEW: THE NAVY'S STRATEGIC AREAS

The Navy is a quality-focused and vision oriented organization within DoD attempting to cope with continued foreseeable downsizing. The Department of the Navy's (DoN's) leadership envisions effectiveness of the Navy and Marine Corps team by leading an integrated force within a quality-focused organization. A cornerstone of its strategic vision is continuous improvement derived from the management philosophy of Edward Demming known as Total Quality Management (TQM). DoD and particularly the DoN is attempting to distribute the same philosophy and principles in a leadership context, Total Quality Leadership

(TQL). The Navy recently identified five strategic goals under the leadership of Lawrence Garret III, Secretary of the Navy and Admiral Frank Kelso II, Chief of Naval Operations (CNO). The Navy seeks continuous improvement in six strategic areas; integration, human resources, education and training, acquisition, innovation and technology, and facilities. Facilities is the primary strategic area of concern for a Public Works Center (PWC).

C. DON'S FACILITIES MANAGEMENT: THE STRATEGY

A set of guiding principles and vision in the year 2000 for the support establishment of the DoN was issued at about the same time as Secretary Garrett released the DoN's strategic goals. The first and foremost principle is that the mission will be accomplished. Other principles include personnel quality, mission loyalty, continual improvement, innovation, integrity, and training. The strategic goal for facilities approved by Secretary Garrett is to:

> "Operate an adaptable and responsive shore facilities establishment that is properly sized and properly supported to allow continuous improvement in the quality of service to the operating forces; that consists of well-maintained and attractive facilities, resulting in improved living and working conditions and increased productivity at all its installations; and that consistently performs in an environmentally responsible manner and contributes to the quality of life in the communities of which it is a part" (Garrett, 1991).

The Department of the Navy vision statement specifically indicates it will:

- Define and implement "quality standards" for facilities that support mission requirements, family and bachelor housing, family support functions, and morale, welfare and recreational activities.

- Provide the resources to achieve the defined quality standards over time and maintain the support establishment at these levels: in additional to traditional military construction, consider innovative financing and

management arrangements (e.g. cost-sharing, public-private venture, leasing).

- Integrate environmental awareness into all DoN planning, management, and operations to comply with all applicable environmental laws and to protect the natural resources found on Navy and Marine Corps installations. Minimize waste, conserve energy, and adopt pollution prevention measures to avoid adverse impacts on the environment.

D. PWCSB'S STRATEGY

As is the DoN, PWCSB is committed to continuous improvement. The strategic vision of higher echelon's has rippled down to PWCSB and its Utilities Department. PWCSB publishes its quality philosophy for its employees. The philosophy statement states customer satisfaction is not the goal. Instead customer enthusiasm for its performance is the ultimate goal. PWCSB recognizes continuous improvement requires innovation, instilling pride of workmanship and timeliness, removing barriers that inhibit achievement of the TQL philosophy, and improving the quality of life for PWCSB and its customers. PWCSB's vision statement identifies six areas to direct achievement:

- Our customers are fully satisfied with all services and products requested or provided; they consider us a member of their mission team.

- The personal and professional expectations of our military and civilian employees are achieved and, as a team, we efficiently apply our skills and knowledge.

- We are viewed by the taxpayers, community, and regulatory agencies as being responsible and progressive contributors to the economy and environment.

- Our suppliers are operating in full partnership and are providing and receiving excellent services.

- We continue to make long term, cost effective capital investments to meet our mission.

- We are making continual, incremental improvements by applying the principles of quality management.

E. THE CHALLENGES OF THE FUTURE

1. NAVFAC

The DoN's shore establishment 's ability to meet the challenges of the future has been tied to continuous improvement deemed possible using TQL principles. The CNO has attempted to instill a new management philosophy throughout the Navy. A DoN written vision statement that was reviewed in Paragraph C is the application of one principle of TQL. Perhaps no greater than in Navy facility management has the new management philosophy of continued improvement been adapted, and perhaps no greater are the challenges facing any community within the Navy than facility management. While reorganization and downsizing system commands is taking place elsewhere, NAVFAC is executing its own restructuring and consolidations.

NAVFAC is the major claimant and command for the administration of the DoN's facilities management responsibilities. Public scrutiny, escalating environmental clean up costs, growing environmental legislation, base closures, competition, and scarcer fiscal resources in the Navy budget are just some of the challenges facing a community which serves the operating forces. Some of the measures taken in the current fiscally constrained environment include reorganization of its field divisions called Engineering Field Divisions (EFDs), consolidation of Public Works Departments (PWDs) to PWCs, striving for continual improvement, and innovative management.

2. Public Works Centers

The ability of PWCs to compete with the private sector was a measure of their continued existence just ten years ago. After improving significantly their service and competitiveness, they became a model for the DoD interservice public works consolidation. The challenge today and in the future is providing support to the operating forces in a downsizing environment with an old and aging infrastructure. While the PWCs' funds are not impacted directly by downsizing, because all costs incurred are reimbursable from customers, PWCs are pressured from customers for quality, affordability, and timely service nonetheless. If customers have complaints, it usually is because service is not up to standards, too expensive, or too slow.

The importance of having a strategy for a challenging environment can not be understated. The success stories in the private and public sectors generally share the communality of having a vision or strategy. This chapter has presented some of the challenges of Navy facilities management and the strategy employed to meet these challenges. A review of Navy facilities management is discussed next to provide the background necessary to understand how PWCs integrate into facilities management, how PWCs historically have performed, and the recent changes brought about by the Defense Management Review Decision 967.

F. PUBLIC WORK CENTERS

1. Facilities Management in the Navy; the PWD

Facilities Management in the Navy is the primary responsibility of NAVFAC and the Civil Engineer Corps (CEC). Facilities management is executed by NAVFAC at varying levels by CEC officers in three broad areas:

Construction and Facility Support Contracts, Sea Bees, and Public Works. Facilities management organizations providing public work services vary from the smaller Public Works Departments (PWDs) to the larger more independent PWCs.

Usually smaller naval installations and installations in more remote locations have a PWD responsible for the base's facilities management functions. For these installation sites, tenants request services from the PWD. The PWD prioritizes the requested services from all tenants so as to operate within the department's budget provided by the base comptroller and Commanding Officer. PWDs compete with all other base departments for operating funds, Operation and Maintenance, Navy (O&M,N) funds. Commanding officers thereby control and influence facility management spending through the fiscal control of O&M,N funds. PWDs are headed by Navy Civil Engineer Corps Officers, usually between the ranks of Lieutenant Junior Grade and Captain depending on the size of the Navy installation. Installations that have larger tenant activities can be staffed with a Staff Civil Engineer (SCE), also a naval Civil Engineer Officer and a Lieutenant, to coordinate requirements for services from the PWD or a nearby PWC. Some PWDs may be large enough to provide facility management as a customer service. In this case an Activity Civil Engineer (ACE), a naval Civil Engineer Officer, can provide customers with a facility management officer. The largest facilities management organization in the Navy is the PWC. [Ref. 2: pp.2-3]

2. Facilities Management in the Navy; the PWC

A Navy PWC is an independent organization headed by a Commanding Officer, usually the rank of Captain, that provides services to all ashore and afloat

activities in its area of responsibility on a fully reimbursable cost basis. PWCs serving customers at multiple installations on a reimbursable basis is the fundamental difference between PWDs and PWCs. PWCs are manned largely by Federal Civil Service employees and usually about a dozen CEC officers. PWCs range in size from about 600 to 3,900 employees and execute from 50 to 300 million dollars of annual business. Typical functional capabilities of PWCs include: [Ref. 2: pp.2-10]

- Engineering and planning consultant and support services
- Inspection of facilities and public utilities
- Recurring and specific maintenance, repair, and minor construction of facilities
- Transportation equipment operation and maintenance
- Family housing administration and maintenance
- Utilities operation and maintenance

3. Navy Consolidation: The Creation of Public Works Centers

Through World War II, facilities management functions at Navy installations and shore commands were performed by PWDs. Where several Navy installations coexisted in the same geographical area, duplication of effort existed in shop issues, labor skills, facilities, equipment, and overhead staffing [Ref. 3: p.1043-2]. Navy PWCs were created to consolidate facility management in these geographical areas when it was economically prudent and did not hinder mission performance. Through the start of FY 92, the Navy maintained nine Public Works Centers (charter dates are provided in parentheses): Norfolk (1948), Pearl Harbor (1952), Subic Bay (1955), Guam (1958), San Diego (1963), Pensacola (1965), Great Lakes (1965), Yokosuka

(1965), and San Francisco (1974) [Ref. 3: p.1043-1]. These PWC sites were established over a 26 year period following World War II .

The basis of Navy consolidation of public work services was to provide the same services with less overhead costs. Where PWDs charge only direct costs, PWCs operating on a fully reimbursable basis, charge their direct and overhead costs to their customers thereby appearing to be more costly. Training manuals state the Navy found that elimination of duplicative overhead of multiple PWDs in the same geographical areas resulted in about 5% less O&M,N funds to operate public work functions.

4. Managing Public Works Centers

a. Some Difficulties

PWCs were managed on a corporate concept. NAVFAC was headquarters and the PWCs were the business divisions, each represented on NAVFAC's board of directors by its respective Commanding Officer. Under the corporate concept, some shortcomings existed. NAVFAC provided centralized management controlling the PWCs' mission performance and functions through policies and directives. PWCs' organizational structures were standardized and inflexible. Instead of analyzing PWCs' performances by measuring customer satisfaction, NAVFAC measured how the centers' costs compared to each other, despite regional differences. The chain of command required PWCs to report to NAVFAC, not the customers which they served. The chain of command created a lack of incentives for service improvement, responsiveness, and cost control. [Ref. 3: p.1043-2]

The Commercial Activities Program attempted to improve PWCs by making industrial and commercial type activities bid against private industry for

services. Although the PWCs improved performance focusing on procedures and the structure for providing service, the customer continued to be generally dissatisfied. If PWCs could not provide services in competition to private industry, their continued existence could be questioned. NAVFAC sought assistance in its corporate management concept while interest grew in the concept of continual improvement based upon the management philosophy of TQL. [Ref. 3: p.1043-2]

A large accounting and consulting services firm, Coopers & Lybrand, was hired by the Secretary of the Navy in 1984 to recommend improvement of the Navy's commercial and industrial activities. The study focused primarily on management and operations control. In a broad overview, Coopers & Lybrand found the PWCs delivered most services at acceptable levels of quality, had a dedicated work force, and reacted well to solving high interest problems but also found that the PWCs were not responsive, were burdened by staff developed systems, and lacked constructive planning and direction. More specifically they found the following shortcomings:

- PWCs did not receive effective guidance or direction
- PWCs had deficient managerial capability
- PWCs mid level management focused on processes and procedures rather than timely quality service
- Utility distribution networks had not been maintained for many years
- NAVFAC's structured procedures could not replace operational planning and control systems
- Annual maintenance plans had not been executed
- Maintenance backlogs were increasing

- No effective system existed for planning, scheduling, and controlling
- Authority and responsibility was diffuse (no project managers)
- No feedback and performance analysis existed
- Recurring work performance and costs were not controlled nor analyzed

b. Solutions and Improvement

Coopers & Lybrand was hired for an additional year to change the way PWCs conducted business. The PWCs developed a Corporate Improvement Plan emphasizing competitiveness with alternate sources of service, a customer based business strategy, and an improved chain of command and control. The plan is revised and published annually. The original Corporate Improvement Plan was a framework for continuous improvement, consistent with principles of TQL. Commanding Officers of the PWCs were given broader guidance and greater flexibility. Commanding Officers for instance were no longer required to organize into a standard PWC organization although basic organizational groups and titles (codes) are used. Recently the Plan has focused on improvements to utilities and family housing, responsive to increased DoN attention and budgeting allotments to these areas. [Ref. 3: p.1043-2]

The first Corporate Improvement Plan area implemented was the new command and control measures. Instead of reporting to NAVFAC alone, Commanding Officers of PWCs now report also to the Area Reporting Senior (ARS). The ARS is the senior flag officer in the area responsible for overall administrative activities in a region. The ARS exercises military command and coordination control over the PWC to ensure that a PWC's activities are coordinated with its customers. NAVFAC provides technical and management

control including corporate policy input, technical guidance, and management under the DBOF system. [Ref. 3: p.1043-2]

The Navy's gains in improving facility management operations through adaptation of TQL principles and the Coopers & Lybrand effort was significant. Although the Coopers & Lybrand effort might have resulted in more immediate gains, TQL is expected to yield long term on-going improvements. Perhaps more than anything, the changes that took place in the mid and late 80s focused on customer service helping to rid NAVFAC of bureaucratic centralization and to establish a more decentralized structure that could better satisfy customers. The Navy improvements in the public works area became a model for change in the consolidation recommended by the Defense Management Review Decision number 967 (DMRD 967) in the early 90s.

5. Department of Defense Consolidation: DMRD 967

DMRD 967 approved 30 December 1990 recommended a plan to consolidate DoD's facility management functions. The plan calls for consolidation of base engineering services and establishment of PWCs that serve all DoD installations within a geographic area. The Defense Logistics Agency and Services (Army, Navy, and Air Force) were to prepare plans for implementing the plan under the guidance of the Under Secretary of Defense for Acquisition (USD(A)). After coordination with the Department of Defense Comptroller, the USD(A) was to submit plans to the Deputy Secretary of Defense for approval by 30 June 1991 for PWCs requiring realignment or establishment in FY 1992 and by 30 June 1992 for PWCs requiring realignment or establishment in FY 1993. These directives are outlined in DMRD 967. DMRD 967 is being implemented as scheduled.

DMRD 967 highlights the enormity of the DoD infrastructure by stating it is extensive with replacement costs of about $600 billion and annual programming of about $5.7 billion. A Defense Management Review (DMR) team evaluated the feasibility of consolidating base engineering services, one of 24 areas under review, through industrial funded PWCs. The Office of Secretary of Defense (OSD) and service military and civilian "experts" were questioned between June and August of 1990. Of the base engineering services analyzed, the Navy system won favor as the best business model. Some of the reasons cited included:

- Better customer evaluations
- Better system of funding for often neglected infrastructure through surcharges in the Navy industrial fund (NIF) rates (full costing)
- Better real property management and greater understanding established by tenant ownership of facilities
- Better business management emphasis
- Better adaptability to DBOF
- Better flexibility relating to manpower and contracting capability
- Better balance in chain of command incorporating line control

DMRD 967 identified fundamental challenges to base engineering service organizations and identified primary customer issues. Commanders were found to want control of their base engineering programs so as to control resources and establish their priorities as they have with PWDs. They also wanted responsive service and shorter project times. The challenges to the base engineering service organizations in DoD were identified as (1) an aging infrastructure that was developed in the World War II and Korean War periods

(NAS Alameda is an example), (2) constrained budgets in the last 15 years, (3) large environmental clean-up expenses, and (4) future budget and force structure reductions.

DMRD 967 states the Navy was identified as claiming annual savings of 5% in its consolidations of PWDs into PWCs. DMRD 967 predicts annual savings of $150 million by establishing a "business-oriented structure" and consolidating engineering base services. The business-oriented structure is essentially reimbursement costing. Consolidation is expected to eliminate duplicative management and support staffs and allow for economies of scale in supply procurement and contracting for services, design services, master planning, laboratory services, hazardous waste/asbestos removal and disposal, heavy equipment pool sharing, and maintenance of equipment and vehicles.

DMRD 967 recommended the following principles in consolidations (not an inclusive list) which appear to incorporate the Navy model:

- Public Works Centers should be established in all Services on primarily an Intra-Service geographic basis. However, in those geographic locations where one Service establishes a PWC and is clearly the predominate DoD component, and no other Service has sufficient work load to warrant a PWC, negotiated Inter-Service Support Agreements should be established where the PWC provides support to all DoD installations in the region, as appropriate for local circumstances.

- Intra-Service Centers should be established serving all activities within a maximum one and one-half to two-hour driving distance. Centers should not be established where the total local program is less than $50 million annually. (This was based on the Navy experience that a PWC needed to be within a one and one-half hour drive of commands it served to be successful and should have programs of a minimum of $60 million annually.)

- All centers should be either industrially funded or operate on a reimbursable unit cost basis to put operations on a business management

basis where full costing and control of indirect expenses is inherent in operations.

- Public Works Centers should be placed in the Service chains of command in such a manner as to ensure responsiveness to line managers and operational command needs. The Navy model may serve as an initial example, but each Service must design and implement these relationships according to their respective requirements.

DMRD 967 recommended expansion of seven PWCs and the establishment of five new PWCs. DMRD 967 recommended the following Navy PWCs be expanded effective in FY 92: Norfolk, Pensacola, San Diego, Great Lakes, Pearl Harbor, and San Francisco. In FY 93 PWC Guam is to be expanded and PWCs at Charleston, Jacksonville, and Washington D.C. are to be established. Centers are to be established in FY 94 at New York and Long Beach, although they are currently on hold. Washington and Jacksonville have stood-up while Charleston is to stand-up 1 October 1993. A staff, a Precommissioning Unit (PCU), is currently in Charleston readying its stand-up. (PWCSB Point Paper, 1992 and CNO memo, 1991)

DMRD 967 is expected to have significant impact on the operations at PWCSB. Business volume is expected to increase from $200 million to approximately $285 million annually and manpower is expected to increase to about 1,900 employees. Effective 2 October 1992, when Mare Island Naval Shipyard was the last expansion site to be formally incorporated in PWCSB, the following Navy activities became PWCSB customers as a result of DMRD 967: Moffett Naval Air Station, Mare Island Naval Shipyard, Skaggs Island Naval Security Group, Concord Naval Weapons Station, and Stockton Naval Communication Station. Skaggs Island and Moffett Naval Air Station are expected to close in the near future. The list of potential customers outside of the

Navy include the National Aeronautics and Space Administration (NASA), General Services Administration (GSA), and Bay area Army assets to include Fort Mason, Fort Baker, and the Presidio. Base closures will limit PWCSB customers in the future as some of them have been identified for base closure while others will likely be identified later.

G. BUDGET PROCESS

1. Introduction to the Navy Industrial Activity

a. *The Navy Industrial Community*

Before the impact of DMRD 971, fifty two naval activities comprised the Navy Industrial community, the largest industrial community in DoD. The Navy Industrial community included shipyards, air depots, ordnance facilities, research facilities, the Military Sealift Command, data automation centers, printing facilities, and PWCs.

Financial management of the DoD Industrial Fund community is provided by the Office of the Secretary of Defense (OSD). Financial management is delegated to the Navy Department through the Comptroller of the Navy (NAVCOMPT) who develops the accounting policies of all Navy industrial activities in the Navy Comptroller's Manual Volume 5. The essence of the Navy Industrial Fund (NIF) process is the revolving fund concept.

b. *The Revolving Fund Concept*

Each Navy Industrial activity was started with working capital for start-up and provided a working capital fund. PWCs generally received from $1 to $5 million dollars for their working capital depending upon their size. Industrial activities convert capital into goods and services by financing all incurred costs.

Cash is put back into the working capital fund when customers pay cash from their O&M,N funds for the goods and services they receive. This approach is reimbursable in nature and customers not only pay for direct costs of services, but also the indirect costs. A number of advantages are realized by using a working capital fund. They include (1) a cost awareness established from a business oriented buyer-seller relationship, (2) a reduction of waste from a customer incentive to request only needed services, (3) the establishment of unit costs, and (4) the flexibility and financial authority to use resources effectively.

Billings for goods and services are based on "predetermined rates," fixed unit cost rates in effect for one fiscal year. The development and utilization of these rates is known as rate stabilization. Variances arise during the year because predetermined rates are budgeted unit cost rates based on cost estimates and workload forecasts developed in prior years, which can not accurately predict actual costs. Variances at the end of fiscal years are rolled over into the next fiscal year and should be factored into subsequent stabilized rates. The objective of Industrial Fund activities is to make zero profit .

c. Reimbursable Accounting

Reimbursable accounting and the objective of zero profit requires sophisticated cost accounting procedures. Most Navy activities receive direct funding in their operating budgets from their major claimant. These funds can be used to obtain goods and services from other activities. If goods and services are obtained from an activity with the same major claimant, the major claimant adjusts resource allocations accordingly by increasing the provider's budget and decreasing the receiver's budget. When the provider is a NIF activity, the provider is paid directly with the receiver's O&M,N funds. The contractual

relationship established in provider and receiver requires the provider have extensive cost accounting procedures for accurate accounting. Accurate cost accounting is necessary to ensure validation of costs and proper charging of costs. Inaccurate accounting records reflect poorly on an activity's ability to manage funds and might not prevent breech of spending limits, a violation of U.S. Code Title 31.

2. Defense Business Operating Fund (DBOF); DMRD 971

The cost conscious business environment brought to DoD activities using the NIF concept was the prelude to DBOF. DBOF is a DoD expansion of the use of the revolving fund concept that is used by the industrial and stock funds. DMRD 971 proposed changes to DoD's financial systems to provide better tools and information to employees and decision makers at every level. The intent of the DMRD's proposals was to improve performance and lower costs of the support establishments by bringing all of the support establishment into DBOF. A guiding principle of the DMRD team was that customers should determine the types and quality of services to be provided.

DBOF proposes unit costing by aligning costs with outputs. To make any support establishment conform, DMRD 971 stated the support establishment must first identify the outputs of the business, have a cost accounting system that relates cost to those outputs, and be able to identify their customers. PWCs can do all these. DMRD 971 recommended the following:

- Establish a DBOF with existing revolving funds and a minimum of new activities for FY 1992
- Initiate Capital Budgeting and set FY 92 rates to recover full costs in the first year
- Assume 1% productivity improvement per year for FY 92 business areas

DMRD 971 suggests the following advantages will be realized:

- Stabilizing prices by unit costing will ensure programs are executed as planned
- Managers will be able to manage more effectively
- Lack of competition will be overcome by a system that focuses on quality and cost reduction
- Customers will demand the products that are produced
- Financial transactions will decrease
- Managers will be responsible for costs but not burdened with cumbersome transactions.

3. DBOF Budgeting at PWCSB; Utilities Department Focus

a. The Process

PWCSB annually prepares a three year budget after the Office of Management and Budget (OMB) publishes circular A-11 which sets the policy and guidance for the budget year. PWCSB's Comptroller is provided budget guidance from the Navy Comptroller and NAVFAC once OMB distributes circular A-11. The three years budgeted include the prior year (a revision of the present fiscal year based on one quarter of actual data and three quarters of estimated data), the current year (a revision of the operating costs for the following fiscal year), and the budget year (two years from the present year).

The PWCSB Utilities Cost Center manager requests budget driver reports from his subordinate managers that estimate future years' sales volume (mega watt hours (MWHs)) for electricity and thousand gallons (KGALs) for water, workload costs (includes procurement and distribution costs), and personnel requirements. Estimates of sales volume and costs are based on historical data, experience, and considerations of projects scheduled for future

years. Staffing requirements are based on historical work load and backlog. Staffing requirements for plant operations and overhead positions are established using zero base budgeting methods. Labor costs include an acceleration rate provided from PWCSB's Comptroller. Project costs, costs associated with planned maintenance other than preventative maintenance, historically have not been amortized but included in lump sum fashion into a subsequent fiscal year for rate making purposes. Cost elements estimated by cost center managers include direct labor, direct material, applied overhead, projects, interutility transfers, contract fees, transportation equipment rental, emergency service chits, hazardous waste surcharge, refuse, miscellaneous small contracts, pest control, applied overhead, and other costs. Many of these costs are costed at a predetermined rate to include applied overhead. All predetermined rates are provided to cost center managers by the PWCSB Comptroller through trial budget data. Cost center managers then determine the break even rate and propose rates, for the A-11 budget, to the Budget Review Board. The Budget Review Board membership includes PWCSB's Executive Officer and Commanding Officer of the PWCSB. Changes are frequently made by the board and are forwarded to NAVFAC for review and further modification. NAVFAC forwards the A-11 budget to NAVCOMPT before its submission to the OSD/OMB review. The OSD/OMB review determines the final rates to be charged. The PWC budgeting process is complex requiring a sophisticated cost accounting system and significant automatic data processing (ADP) and Comptroller support.

The driver reports provided to cost center managers appear instrumental in the forecasting ability of the budgeting process. Estimates are

generated and provided to the Utilities cost center manager on these reports. PWCSB management questioned the effectiveness of their ability to forecast repair and maintenance costs. Management believed that the private sector, particularly public utility companies, might use more sophisticated budget techniques to forecast costs, such as the use of algorithms.

b. *PWCSB's DBOF Impact and Budget Complexities*

No longer being a NIF activity, PWCSB became a DBOF activity in the beginning of FY 92. The DBOF budget process at PWCSB does not significantly differ from past budgeting processes as DBOF is largely an extension of the reimbursable costing system used by the Industrial and Stock Fund activities. However, the two major differences include:

- Assets will be depreciated
- Rates are to make up past losses or distribute past gains

Although the theory of the Industrial Revolving Fund concept was to obtain zero profit, historically PWCSB has let losses be rolled over into following fiscal years without serious attempts to recapture losses in subsequent predetermined rate increases. Historically the utility stabilized rates in the aggregate (electricity, water, steam, gas, etc.) provide variance gains while most other aspects of PWCSB variances are losses. PWCSB's accumulated operating result (AOR), defined as the accumulated variance of actual and budgeted costs over all years of operation, as of 1 October 1990 for example was ($19,469,637). Brackets indicate monetary values that are negative. Operating results during FY 91 were ($7,595,020) although utilities accounted for a positive variance of $966,867. Electricity, sewage, gas, and air provided positive variances while water and steam provided negative variances. Adjustments to the working

capital fund of $18,000,000 were necessary during the year by acquiring capital from higher authorities.

PWCSB's Comptroller's staff perception is that DBOF will require utility rates to be adjusted annually to collect utility loses or distribute utility profits which is intended to force better management of the working capital fund by avoiding erosion or gain in the fund. PWCSB's Utilities Department's perception is that DBOF will result in great pricing fluctuations and that the political nature of utility pricing will not change under DBOF. The political nature of pricing is discussed in the following paragraph. Because DBOF is still relatively new, different perceptions exist and how it will impact PWCSB's utility pricing is unknown.

The political nature of the budget process has historically impacted the rate making process. From PWCSB's Financial and Operating statements for FY 91, the following were budgeted:

- electricity was budgeted for a loss of $233,166 with a rate of $95.10/MWH,
- water was budgeted for a loss of $507,511 with a rate of $4.00/KGAL,
- steam was budgeted for a gain of $2,557,526 with a rate of $15/Mega British Thermal Units (MBTU),
- sewage was budgeted for a loss of $959,519 with a rate of $4.05/KGAL,
- gas was budgeted for a loss of $305,723 with a rate of $4.70/MBTU, and
- pneumatic air was budgeted for a loss of $430,640 with a rate of $0.60/Kilo cubic feet (KCF)

The budgeted aggregate for the utility commodities was a gain of $130,967. The actual operating results were $1,097,834 representing a forecasting error of 838% with forecasting errors of 517% for electricity, 352% for water, 1% for

steam, 82% for sewage, 170% for gas, and 245% for pneumatic air. Average forecasting error (budgeted gain or loss as compared to actual gain or loss) of the commodities was 228%. PWCSB attributes most variances to changing project priorities or Desert Shield Operational impacts. Data was not provided for other years. The FY 91 data indicates the rate making process for utilities is highly unreliable.

Utility commodities are not priced in all cases to consider any rollover of gains or losses in past years, indicating that some utilities are priced intentionally to subsidize other utilities. The FY 91 budget data in the preceding paragraph indicates steam was intended to subsidize all the other utilities. Water incurred a loss of $3.2 million in FY 89 at a rate of $4.07/KGAL. If any rollover effect on a commodity was a basis for rate making, the $3.2 million loss should have caused increased rates the following year. The rate in fact was lowered to $3.87/KGAL resulting in a $3.4 million loss in FY 90. In FY 91 the rate was $4.00/KGAL resulting in a $2.3 million loss.

For the amount of labor and effort that goes into the budgeting process at PWCSB, utility commodity forecast errors of 228% is indicative of a need for better budgeting techniques in the process. Although the budgeting process was not a primary focus of the research, three shortcomings are identified: (1) the political nature of the rate making process, (2) the lack of decentralization to change the rate structure after rates have been set, and (3) the timing of the rate making process. These are discussed further in Chapter V.

The chapter has provided significant background as to the current fiscal environment, its outlook, and what strategy has been formulated to meet the challenges of the future; namely, TQL. Facilities management organization

and the development of PWCs was introduced to include consolidation requirements brought about by DMRD 967. A discussion of the budgeting processes resulted in identification of three shortcomings named above. The remaining portion of this chapter is devoted to the introduction of the four sites participating in the research. PWCSB and NAS Alameda are discussed first followed by the three non-DoD sites.

H. PUBLIC WORKS CENTER SAN FRANCISCO BAY (PWCSB)

1. Establishment

PWCSB was established in 1974 when DoD ordered several Bay Area PWDs to consolidate into a single centrally located PWC. Twelve CEC officers and 1,200 civilian employees established the Center 1 July 1974 [Ref. 4: p.C-1]. Its customers included Hamilton Air Force Base and DoD housing facilities, Point Molate Fuel Depot, Treasure Island/Yerba Buena Island, Oakland Naval Hospital, Western Division Naval Facilities Engineering Command (WESTDIV), Oakland Army Base, Naval Supply Center Oakland (NSC Oakland), Alameda Facility, and NAS Alameda [Ref. 4: p.C-1]. DMRD 967 DoD consolidation has expanded its customer base to include Mare Island, Concord, Stockton, Skaggs Island, and Moffett as previously mentioned.

2. Mission

The mission of PWCSB is to provide public works, public utilities, public housing, transportation support, engineering services, shore facilities planning support, and all other public works type logistic support required by the operating forces, dependent activities, and other area commands [Ref. 4: p.C-1]. The focus of the research was the public utilities mission.

3. Organization

Primary support responsibility, to include corporate policy input, technical guidance, and management under the DBOF system, is assigned by the CNO to NAVFAC. PWCSB's line chain of command, as shown in Appendix A Figure 1, is the ARS, Commander Naval Base San Diego and the designated sub-area coordinator representative in San Francisco. PWCSB is divided into 23 departments as shown in Appendix A Figure 2. PWC consisted of approximately 12 naval officers and 1,300 civilian employees before consolidation; however, employees now total about 1,900.

4. Economics

PWCSB executes about $250 million dollars in business. PWC is an integral part of the Bay Area economy with an annual payroll of over $48 million. Materials of over $12 million are procured from local sources. PWCSB provides work for construction and service contractors by contracting for services valued over $120 million annually. Because the monetary amounts are based on 1985 data and on estimates for the impact of consolidation (20% was added to 1985 data), they are approximations and believed to be conservative. PWCSB will add an estimated $85 million of annual business volume to the Bay area as a result of the DMRD consolidation. Fundamentally, this represents a shift of business volume from the five expansion sites to PWCSB. [Ref. 4: p.C-8]

5. Utilities Department

The Utilities Department provides and maintains utilities to its customers representing over half of the work of PWCSB. The department provides electricity, water, sewer, gas, steam, pneumatic air, salt water, hot water, and non-potable water services. The Utilities department is organized as shown in

Appendix A Figure 3. Specific missions of the department include: [Ref. 4: pp.C14-15]

- Heating Plant Operations: Operate and maintain seven large boiler plants and several small heating plants
- Electric Power Plant Switchboard Operations: Operate and maintain electrical switching station and distribution systems
- Refrigeration Plant Operation: Operate and maintain refrigeration cold storage facility
- Water Sewage Treatment Plant Operations: Operate and maintain sewage treatment plants
- Air Compressor Plant Operations: Operate and maintain two air compressor plants
- Waste Treatment Plant Operation: Operate and maintain four industrial waste treatment facilities
- Instrumentation Maintenance: Execute as required
- Billing functions: Execute for all utility systems
- Distribution System Operations and Maintenance: Maintain distribution systems for water, sewage, steam, air, and electricity

I. NAVAL AIR STATION ALAMEDA

1. Establishment and Mission

Established in the World War II era, the mission of Naval Air Station Alameda is to provide support to aviation activities and operating forces as designated by the CNO. The support population consists of 19,000 personnel: 12,000 active duty; 2,000 reservists; and 5,000 civilians. An additional 3,000 personnel reside as family members. The major tenant is Naval Aviation Depot

(NADEP). NAS is home port for two aircraft carriers, two cruisers, a destroyer tender, and an active duty helicopter mine countermeasures squadron.

2. Facilities

NAS Alameda is comprised of 2,720 acres of land, water, and airspace easement [Ref. 5: p.C-1]. From the property plant records printed in August of 1992, NAS has 287 structures comprising 5,691,285 square feet. NAS can be thought of as a small town complete with industrial, commercial, recreational, and residential facilities. NAS is mostly industrial in nature with industrial shops, aircraft hangers, warehouses, and storage accounting for three fourths of the installation's square footage (not to include single family residential facilities). Industrial shops account for the most square footage (47%) on NAS; NADEP occupies 50% of all industrial shops. Hangers and warehouses account for about 19% of the total NAS square footage. Administration facilities represent about 7% of NAS's square footage as do multi-unit housing facilities.

3. Utility Distribution Systems

Because NAS is PWCSB's largest customer of utility services and has been the focus of PWCSB's cost reduction efforts, NAS's electrical and water distribution systems were the focus of the research. A detailed narrative describing the systems is provided below. A system description is necessary so that site managers can draw conclusions regarding other systems when comparing data from the next three chapters.

a. Electricity

Most of the industrial electric power distribution system is approximately 47 years old. The pier electrical network is approximately 10 years old. Other parts have been rebuilt, while still others were added to extend

new loads to the system. The system is generally in good condition. From the PWC Master Plan distributed in 1985, the networks total 322,507 feet of line [Ref. 4: p.C-14]. The unique uses of electricity at NAS include shore power for naval ships and the NADEP wind tunnel. NAS differs from the other sites in its heavier use of industrial processes.

Electric power is delivered by two 115KV transmission lines connected to a Pacific Gas and Electric (PG&E) transmission system. PG&E is the regional supplier of electricity and gas in northern California and is the largest distributor of electricity in the country. Although the distribution system uses two PG&E transmission lines, electricity is supplied by Alameda's Bureau of Electricity. A City of Alameda and Navy 115KV to 12.5KV substation contains city 15KV switch gear and Navy 15KV switch gear from which 12.47KV underground feeders supply eight of eleven substations. The other three substations are fed by interconnections to these eight stations. These 12.5KV feeders and the interconnections between substations are operated with the circuit breaker closed to form two highly reliable primary networks. Power is further stepped down in 11 substations to either 4.16KV or 480V for secondary distribution. Utilization voltages are at 4.16KV (one aircraft carrier and large motors) or at 480/277V (one aircraft carrier), 208/120V and 120/240V. Secondary radial 4.16KV distribution feeders supply loads near the substation and are able to serve large loads without an excessive drop in voltage. To limit the expansion of the 4.16KV system, large new loads are fed at 12.5KV when feasible through underground cable in duct banks, except in housing areas where overhead lines are used. [Ref. 6: pp.1.1-1.4]

b. Water

The water systems, not recently replaced, are approximately 49 years old. A water system line replacement project for the south half of the base was completed in FY 91. Water lines were estimated to include 196,000 linear feet in a Bechtel Utility Technical study of which 63% are cast iron, 34% asbestos-cement, 3% steel, and less than 1% copper. [Ref. 6: p.4.31]

East Bay Municipal Utility District (East Bay MUD) supplies water through three primary feed lines entering NAS from the west, one 8" cast iron line, a 10" or 12" cast iron line, and an 8" or 12" cast iron line. Two other primary supply lines consist of an 8" cast iron line and a 12" carbon steel line. Housing south of Arnold Avenue is supplied by a 6" carbon steel line. The potable and fire protection water systems consists of a series of 6", 8", 10", 12", and 16" pipeline loops of various pipe materials. These line loops are generally located within the major streets and underneath piers. Pier systems are provided with sectional valves to isolate segments of the system during maintenance and repair. [Ref. 6: pp.4.2-4.8]

The potable water system on the wharf and piers consists of tar coated 6" and 8" carbon steel lines supported by hangers from the underside of the piers. The piers have 24 potable water stations. Fire protection water for piers is supplied from four booster pumps driven by two diesel driven and one electric motor driven centrifugal pumps. Fire protection water is supplied to ships at 13 stations located in the pier deck. Each station has a flush type fire hydrant and is covered by a cast-iron frame and hinged access hatch. One chlorinator system for potable water exists to chlorinate water used by ships. Fire protection

water for another pier is supplied from a saltwater pumping station. [Ref. 6: pp.4.2-4.8]

J. NON-DOD SITES

The site descriptions are intentionally not provided to impede identification of the participating sites. Site 1 is a non-DoD public enterprise in the local Bay area. Sites 2 and 3 are non-DoD private enterprises in the local Bay area.

1. Site 1

Site 1 procures electricity from PG&E and procures water from East Bay MUD. The electrical distribution system is an underground 12KV electrical distribution system less than five years old. The last phase of construction ended in 1991. The 12KV system is a single voltage system with four substations equipped with a double bus system. Dual feeders between substations and dual subfeeders to buildings provide redundancy. The length of the electrical distribution system is estimated at more than 398,000 feet. Budget documents noted that over 350,000 feet of line was in place before construction of step 3 of the new system. From review of planning documents, the new system added an additional 48,000 feet of new cable in new duct banks while the other 48,000 feet of new cable replaced old cable in existing duct banks. The combination of the data resulted in the estimate of 398,000 feet of line. The age of the water distribution system varies in age and is as old as 100 years. Site 1 has 157 structures accounting for 5,731,905 square feet. The majority of the structures are administrative, multi-unit housing, and recreational.

2. Site 2

Site 2 procures electricity from a cogenerator producer of electricity and uses PG&E as a reserve supplier when demand can not be met by the

cogenerator. Water is procured from a city source. Electricity is brought to Site 2 via two 60KV lines. They terminate at the site's substation where two 16MV transformers transform the electricity to 12KV. The substation also contains a 1-5 MVA transformer for 60KV to 4160V utility service. The cogeneration power supplier located on site feeds approximately 45MW into the substation. Of the 45MW, 21MW is used on site and 24MW is sold to PG&E. Most profits of the cogenerator are obtained from the sale of electricity to PG&E. The electrical distribution system is underground. The water system includes procurement from a city source and use of well water on site. Unique uses of water include computer and laser cooling. The electrical and water systems are in good condition and vary in age depending on the systems locations from 30 years of age to 115 years of age. Site 2 has about 673 structures accounting for 11,809,832 square feet. The majority of the structures are administrative, multi-unit housing, laboratories, and medical facilities.

3. Site 3

Site 3 procures electricity from PG&E and water from the city in which it resides. Site 3 has a non redundant 12KV loop system of 5,400 feet. There are seven substations distributing electricity at 408/480V to over 6,000 feet of line. Water usage is heavily weighted towards landscaping and marine uses. The electrical and water systems are about seven years old and in good condition. The water system has two feeds, a 12" and an 8" line, for a loop system. Site 3 has 57 structures accounting for 65,940 square feet. The majority of the structures are for administrative and small shop purposes.

The level of detail at each of the sites is purposely vague to minimize the potential for site identification. The Utility Departments organization that could be

obtained for the three non-DoD sites are provided for reference in Appendix A. A minimum level of knowledge of the site data presented above prepares the reader for comparison of unit cost data. Chapter IV presents the cost data for NAS. The data for the non-DoD sites is provided in Chapter V. Prior to the presentation of unit cost data in Chapters IV and V, the research methodology is presented in the next chapter. Chapter III describes the criteria used for site selection and discusses the nature of unit costing. The data collection design and pertinent cost terminology as it relates to this thesis is also reviewed.

III. METHODOLOGY, DEFINITIONS, AND CONCEPTS

In this chapter the research structure is reviewed to include discussion on unit costing, data collection design, methodology, and cost terminology. Site selection considerations are first reviewed though. Then a discussion on unit costing explains why a unit cost analysis is appropriate for this research. A discussion on the data collection design and research methodology employed follows. This chapter concludes with a discussion of costs terminology unique to cost accounting and this thesis.

A. SITE SELECTION

Research sites were selected to provide a unit cost comparison with PWCSB based on several considerations. The foremost considerations were that the organizations be non-DoD and located within the San Francisco Bay area. Non-DoD entities were considered important because data were desired from sources that are not constrained or subject to DoD procurement strategies, management practices, maintenance philosophies, and regulations. In addition to non-DoD entities, location within the Bay area was important to maintain similar environmental factors that is a factor of utility costs. Among other reasons, the study maintains a regional focus because comparable labor costs, material costs, and other geographically influenced factors were desired. Secondary site selection considerations included comparable utility distribution systems, utility demands, and facilities. These were secondary considerations because DoD installations are very unique in their diversity of energy and facility uses making comparisons with non-DoD sites difficult.

Non-DoD entities do not exist within the San Francisco Bay area that perform the variety of functions as NAS Alameda and that have the size in land mass, facilities, and energy usage. The diverse functions performed at NAS facilities include industrial, commercial, military, and residential uses. Even if they lack the industrial complex maintained at NAS, the non-DoD sites that were considered for the research were deemed the most comparable sites to NAS that fit the criteria of being a local non-DoD organization. Although site identification is not made, the sites of consideration included cities, theme parks, universities, oil refineries, NASA, major computer firms, large aerospace firms, and other significantly sized business firms. The actual participants of the study may or may not be included in this listing. Disneyland was considered as a highly desirable participant outside the local area but refused participation in the research.

Of the non-DoD sites considered, eight were contacted while one site not considered for selection offered assistance and was perceived to be seeking participation in the study after three sites had already been selected. Ironically that site was Alameda's Bureau of Electricity. Although secondary considerations were considered as indicated above, site selection was also driven by who would devote the resources and time to participate in the study. The sites selected represented the sites perceived to be the most interested in the study and also the most cooperative sites. Site 3 was selected primarily for comparison of overhead and indirect costs.

B. UNIT COSTING

Because of the inherent differences in the sites of comparison, unit cost comparison analysis is considered the best analysis method to compare utility

procurement and distribution costs. By comparing unit costs for PWCSB, the research should benefit managers in a number of ways. Unit costing increases the visibility of costs. The visibility of unit costs can often result in better allocation of resources as compared to bottom line budgeting that is used in much of government. Unit costing can also be used to evaluate performance and budgets. In fact unit costs could also be used to establish budgets. The focus of this research is to evaluate performance. Unit costing is believed to make managers focus on the numerator and denominator of a unit cost. Being a NIF and now a DBOF activity, PWCSB is very accustomed to the unit cost approach. Although unit costs treat all costs as variable costs, it is an effective tool to be used for comparisons if similar costs are pooled at each site.

C. DATA COLLECTION DESIGN

PWCSB defined the research as a cost comparison of a utility commodity. The parameters of the cost comparison were undefined. The costs of a single commodity were identified to be procurement and distribution costs. The latter included preventative maintenance, repairs, and capital improvements. To the extent sites' accounting systems could collect costs in this manner, this was the breakdown of distribution costs that were attempted to be collected. Direct costs were the primary focus of the research collection effort. Direct labor, direct material, and other direct costs were the components of direct costs that were planned for collection. Direct labor costs were intended to be collected by straight time and overtime as well as by base rate and base plus fringe rate. All work was planned to be broken down by in house work and contracted work. Overhead and indirect costs were a secondary focus of the research. Overhead costs were intended to be collected on the corporate structure as well as indirect

costs collected on the Utility Departments. Several of the indirect cost pools were proposed for comparison such as supervision costs.

D. METHODOLOGY

PWCSB's unit cost for the procurement and distribution of electricity and water at NAS Alameda were calculated for comparison with the local non-DoD sector. The two primary research methods used for data collection at PWCSB and the three sites were opinion and archival research.

1. Interview and Survey

The opinion research consisted of informal interviews with various levels of management and production supervisors and personnel. Informal interviews were used primarily to enhance our understanding of the different organizations and their accounting systems. First, interviews with management were conducted to gain an overall understanding of the organization and the various departments within an enterprise. Following this were discussions with the production department supervisors and personnel to understand an organization's utility system, methods of system maintenance, procurement, and other areas. Finally, accounting and financial personnel within an enterprise were interviewed to gain an understanding of the accounting system and methods used to capture costs of the organization. PWCSB permitted the greatest access to personnel while non-DoD sites prevented the researchers from gaining access to accounting departments and staff.

Informal interviewing was selected as the best method for gaining an understanding of an organization because it is more adaptable than formal surveys and questionnaires. Adaptability was essential because each enterprise presented unique systems, organization, maintenance, accounting, procurement

arrangements, and personalities. The researchers had no personnel connections with any of the non-DoD sites. Survey approaches at the onset of research were not possible because of the researcher's unfamiliarity with the utilities industries. The researchers worked first with PWCSB so as to gain knowledge in utility management, operations, and industry language. [Ref. 7]

When field research became less productive and the researchers knowledge base grew, surveys were used to try to elicit information and reduce travel costs. Sites were visited in succession (PWCSB, Site 2, Site 1, and Site 3) and as the interviewing became more frequent, a set of questions emerged that was asked of all sites. PWCSB reviewed the questions and provided input. These questions later took the form of a survey so as to confirm with each site the answers received and to permit each site an opportunity to amplify answers as deemed necessary. The survey and questions of each site are provided in Appendix H. A survey was also used to determine electrical system distribution activities that generate costs and are also included as Appendix I.

2. Archival Research

Archival research was used for data collection. Primary archival documentation was always used before secondary documentation. An example of the primary documents used includes utility bills. If original billings were not available then secondary sources were used. An example of secondary documentation is a spreadsheet used to record utility billings. Numerous site visits were conducted to collect the archival information required during this field study. Field research was necessary to supplement the informal interviewing so as to establish personal relationships with the personnel at non-DoD sites and to provide face to face communication promoting responsive interaction. [Ref. 7]

E. COST TERMINOLOGY

This section will define various terminology used in cost accounting and provide the method of cost accumulation for the analysis. Cost accounting is a method of accounting that records the cost of a good or service. Cost accounting is a branch of accounting that is used primarily for internal managers and external evaluators to help in determining the effectiveness or benefits of alternative decisions. For the purposes of this thesis, costs for the procurement and distribution of utilities were measured and recorded in terms of (1) direct cost, (2) indirect cost, (3) overhead cost, (4) contract cost, and (5) procurement and distribution cost.

1. Direct Costs

Direct costs are costs that can be explicitly and unambiguously attributed to a product or service. Usually these costs are for direct labor and material involved in producing a good or service. The direct costs shown later in this thesis for the preventative maintenance, repair, and capital improvements of the utility distribution systems are only for the labor and materials actually devoted to a particular job. Direct labor costs in this thesis also include only base rate labor costs. Acceleration, fringe, and benefit costs are not included in the direct labor costs. [Ref. 8: p.767]

2. Indirect Costs

Indirect costs are costs that cannot be precisely attributed to an individual product or service. These costs are normally associated with more than one good or service and must be allocated by some method. An example of indirect cost is supervisory labor costs. Usually shop supervisors do not work directly on a product or perform a direct service; instead their work is directed at

a number of products or services. A shop supervisor's cost must be allocated to all of the various goods or services. [Ref. 8: p.783]

3. Overhead Costs

In practice overhead costs and indirect costs are frequently used synonymously. Neither cost can be precisely attributed to an individual product or service. However, in this thesis a distinction will be made between the two. Overhead costs will refer to costs incurred by an enterprise's corporate level management and service departments outside of the Utilities Department. Corporate level management and service department costs provide benefit to the entire organization and are allocated to production departments within an organization by various methods. An example of these costs are the general and administrative (G&A) costs at the corporate level within an organization. G&A costs at the corporate level are usually for upper level management, clerical staff, accounting staff, and numerous other corporate functions that provide benefit to the entire organization. These costs are not attributable to one product or even necessarily to one production department; however, they must be allocated to the final product for unit costing purposes. [Ref. 8: p.798]

PWCSB allocates G&A by production labor hours which is typical of American companies in the private marketplace. Allocation of overhead costs by labor hours has been criticized as being antiquated in an environment where industry is largely automated. Although PWCSB is a manual intensive service organization, its allocation method of overhead costs has been criticized by internal management as "unfair". Some production departments are believed to require more support from service and general administrative departments than allocation by production hours captures. Seeking alternative allocation methods

was PWCSB's alternate research topic offered to the researchers. This is an area for further research but is unrelated to the subject of this thesis and is therefore not included in Chapter VII as a recommendation for future research.

4. Contract Costs

Contract costs, as used in this thesis, refer to utility system distribution costs with a third party private contractor. The contract costs shown later in this thesis for the preventative maintenance, repair, and capital improvements of the utility systems are for the total amount charged for the work performed, which provides the contractor reimbursement for direct costs, indirect costs, overhead costs, and profit. Contract costs are only applicable to the individual system listed.

5. Procurement and Distribution Costs

Procurement costs, as used in this thesis, refer to the actual cost for purchasing a commodity from a utility company. Procurement costs refer to the total billing amount received by the sites under analysis. Procurement costs do not refer to the rate the individual sites may charge their "customers" for reimbursement. Distribution costs referenced throughout the thesis are the direct costs of direct labor (base rate only), direct material, and contract costs to perform preventative maintenance, repairs, and capital improvements on the distribution system. As will be evident in Chapter V, data limitations limited the unit cost comparison only between procurement costs and the distribution costs of preventative maintenance and repairs; however, the definition of distribution costs includes capital improvements as well.

The next chapter presents the unit procurement and distribution costs for the electrical and water utilities at NAS. Although capital improvement costs are

not included in the comparison between sites, they are included for NAS data presented in Chapter IV. This convention is maintained in the following analysis chapters; in that when data permits, individual site data is provided. When data is inconsistent for comparison purposes, it is excluded from the comparison. The unit cost comparison begins in the next chapter with the presentation of electricity and water unit costs for NAS.

IV. ANALYSIS OF NAS ALAMEDA DATA

In this chapter NAS Alameda's unit cost data from FY 89 to 91 for electricity and water utilities will be compared. NAS fiscal year data will be compared in two primary areas (1) procurement costs, and (2) distribution costs. Only direct costs are presented in this chapter. None of the data includes applied or actual overhead or indirect costs.

First, the approach and assumptions used for collection of the data will be examined. Second, unit costs in the primary areas of procurement and distribution are presented. Lastly, costs for procurement and distribution will be combined to present a total unit cost for each utility.

A. NAS ALAMEDA ELECTRICITY PROCUREMENT

1. Data Collection and Billing Structure

PWCSB procures NAS Alameda's electricity from the Bureau of Electricity, City of Alameda. The Bureau of Electricity is overseen by Alameda's Public Utilities Commission which determines the Bureau's annual revenue requirement and rate structure. The Bureau of Electricity claims it pays approximately $55/MWH for its electricity which constitutes 70 - 75% of their total costs. The remainder of their costs are for administration, operations, maintenance, retiring debt, and capital improvements. The Bureau of Electricity is NAS's sole source of power. The Bureau's billings separate procurement costs into seven elements: (1) customer charge, (2) peak demand charge, (3) energy charge (4) baseline subsidy, (5) fuel cost adjustment, (6) voltage discount, and (7) power factor adjustment. Each of these elements is defined below.

The customer charge is a fixed monthly amount designed to cover meter reading costs. Customer charges for 1989 were $900 increasing to $1,000 by 1990 and through FY 91. The peak demand charge is a sum resulting from a rate levied against the highest demand during the month. The peak demand rate was constant at $12.50/KWH during the fiscal years analyzed. The energy charge is a flat rate unit charge, similar to the peak demand charge except the energy charge is applied to total electricity consumption. Energy charges varied from $9.59/MWH to $29.03/MWH during FY 89, 90, and 91. The baseline subsidy is a charge NAS pays as necessary to maintain the city of Alameda's domestic rates at baseline levels. Fuel cost adjustments are levied as required to recoup the Bureau's direct variable fuel costs. NAS receives a voltage discount because delivery of electricity is made at the same voltage as that of the distribution line which supplies service. Finally, a power factor adjustment is levied whenever NAS's average power factor load in a month is less than 95%. The power factor, defined as "usable power/power delivered", is decreased when electric current lags voltage. The Bureau of Electricity is penalized by one of its suppliers, PG&E, for power factors below 95% and therefore passes this cost on to customers who contribute to the cause.

Electricity charges for NAS were validated by applying the prevailing rate schedule to the electricity usage shown on the electricity bills. This data was then verified with the amounts billed, Western Division Naval Facilities Engineering Command (WDIV's) Utility Procurement Reports, and internal PWCSB spreadsheets. NAS electricity procurement costs are considered highly reliable. The monthly charges for a loan repayment to the Bureau of Electricity were subtracted from the billings because their inclusion would not be valid for

comparison with electricity procurement costs at the other sites. The loan repayment is not a procurement cost but a financing cost.

Summarizing data from actual monthly billing statements, the procurement costs for NAS's electricity are displayed in Appendix J Figures 5, 6, and 7 for FY 89, 90, and 91. Electricity cost data are displayed on a monthly basis as is the convention throughout the appendix procurement data. The monthly basis can permit analysis of seasonal trends in costs although this thesis does not perform such analysis. Figures 5, 6, and 7 also show average daily demands, monthly unit costs, average monthly costs, total demands, total costs, and annual unit costs.

NAS's electricity charges will be broken into four components for examination below: (1) total charges and usage, (2) peak demand charges, (3) energy demand charges, and (4) fuel cost adjustments. All tables in Paragraphs 2 through 5 below are constructed from Figures 5, 6, and 7, in Appendix J. Appendix J and table data exhibited are subject to rounding error; however, the totals and percentages are based on unrounded inputs.

2. Total NAS Alameda Electricity Charges and Usage

Table 2 exhibits NAS Alameda's FY 89, 90, and 91 electricity cost and usage data from Appendix J Figures 5, 6, and 7. Total electricity procurement costs for NAS declined by 10% from FY 89 to 90 and by 2% from FY 90 to 91 for a total 12% decline over the selected years of review. The decline in total electricity procurement charges was completely due to the decreasing consumption at NAS. Total electricity usage declined by 11% during the FY 89 to 90 time period and by 7% from FY 90 to 91 for a total decline of 17% during the three fiscal years. Although total procurement costs and usage declined during

the period analyzed, the average yearly unit cost increased by 6% over the three fiscal years.

TABLE 2

TOTAL NAS ALAMEDA ELECTRICITY PROCUREMENT

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$11,584,050	$10,426,281	$10,181,345
Total Electricity Usage (MWH)	164,681	146,349	136,828
Electricity Procurement Unit Cost	$70.34	$71.24	$74.41

3. NAS Alameda Peak Demand Charges and Usage

The second component of electricity charges, peak demand charges are reviewed next. Table 3 below shows NAS Alameda's peak demand charges and usage data for FY 89, 90, and 91. The charge for peak demand during the three years evaluated remained constant at $12.50 per kilowatt hour (KWH). On an annual basis, the monthly peak demand charges were added to arrive at a yearly peak demand usage. Over the three year period, peak demand charges and usage decreased by 12% from FY 89 to 90 and 1% from FY 90 to FY 91 or about 6% annually. Over the three fiscal years analyzed, peak demand charges as a percentage of NAS's total electricity bill remained relatively constant at approximately 38%.

TABLE 3

NAS ALAMEDA PEAK DEMAND

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$11,584,050	$10,426,281	$10,181,345
Total Peak Demand Cost	$4,509,000	$3,973,500	$3,948,000
Total Peak Demand Usage (KW)	360,720	317,880	315,840
Peak Percentage of Total Cost	38.92%	38.11%	38.77%

4. NAS Alameda Energy Charges and Usage

Table 4 shows NAS Alameda's energy charges and usage data for FY 89, 90, and 91. Energy charges is the third component of review of NAS's electricity charges. Although NAS's electricity consumption decreased by 17% during the fiscal years analyzed, its energy demand charges increased dramatically by 145%. Additionally, energy demand charges increased from representing only 14% of total procurement charges in FY 89 to representing 38% of total procurement charges in FY 91. The cause of these changes was an energy charge rate change in February of FY 90 from $9.59/MWH to $28.24/MWH. At the close of FY 91 the energy demand charge rate was $25.12/MWH. The restructuring of the rate schedule to a higher unit energy charge provides greater incentive for NAS and PWCSB to continue their conservation efforts in reducing overall consumption.

TABLE 4

NAS ALAMEDA ENERGY CHARGES

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$11,584,050	$10,426,281	$10,181,345
Total Energy Demand Cost	$1,579,286	$3,170,050	$3,864,122
Total Energy Usage (MWH)	164,681	146,349	136,828
Energy Percentage of Total Cost	13.63%	30.40%	37.95%
Average Energy Unit Cost (MWH)	$9.59	$21.66	$28.24

5. NAS Alameda Fuel Costs Adjustments

The final component of electricity charges to be reviewed for NAS is fuel cost adjustments. Table 5 shows the costs associated with NAS Alameda's fuel adjustment charges incurred during FY 89, 90, and 91. The savings from reduced fuel adjustment charges were $1,975,453 between FY 89 to 90 and

$868,828 from FY 90 to 91. The decline in fuel adjustment charges outpaced the decline of NAS's electricity consumption by about 3:1 because fuel adjustment charges declined 55% during the three years while total energy usage decreased 17%. Fuel adjustment unit cost correspondingly decreased 46% over the fiscal years examined.

TABLE 5

NAS ALAMEDA FUEL ADJUSTMENT CHARGES

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$11,584,050	$10,426,281	$10,181,345
Total Fuel Adjustment Cost	$5,189,944	$3,214,491	$2,345,663
Total Energy Usage (MWH)	164,681	146,349	136,828
Fuel Adjustment % of Total Cost	44.80%	30.83%	23.04%
Average Fuel Adjustment Unit Cost	$31.52	$21.96	$17.14

6. NAS Alameda Electricity Procurement Cost Summary

This paragraph summarizes the cost components displayed in Paragraphs 2 - 5. While electricity consumption decreased by 16.91% between FY 89 and 91 for an average annual decline of 8.46%, cost savings only averaged 6.05% annually or about $701,350. See Appendix C for the average annual cost savings breakdown. Energy demand charges increased significantly over the three year period representing the largest cause of costs increases. The offsetting charge was a decline in fuel costs adjustments, shifting the cost burden from fuel cost adjustments to total energy usage. Energy demand and peak demand charges represented over 75% of the total procurement charges levied in FY 91. Continued conservation and monitoring of both peak demand and total energy usage will continue to provide the greatest opportunity for electrical procurement savings. A trend analysis of NAS usage could direct management's

efforts toward this effort and is included in Appendix D. Having completed data presentation on NAS's electrical procurement costs, NAS's cost discussion will next focus on electrical distribution costs.

B. NAS ALAMEDA ELECTRICAL DISTRIBUTION COSTS

1. Data Collection

NAS Alameda's electrical distribution system is maintained by PWCSB. The electrical distribution costs for NAS are displayed by Job Order Number in Appendix J Figures 8, 9, and 10. The electrical distribution costs shown were obtained from PWCSB by analyzing their data collected in the year end Job Order Cost Report Number 3A77. Because direct costs were the focus of the research, only costs in the 3A77 considered directly related to maintaining NAS's electrical distribution system were utilized for this unit cost analysis. Direct labor costs include the base rate only. Where direct costs are listed in the 3A77, they were utilized. When work was performed and charged at a predetermined rate, direct costs were calculated based on percentages derived from budget data in schedule B of the A-11 Annual Financial and Operating Budget report. Costs for applied overhead and predetermined overhead, as calculated from the A-11, were not included in distribution costs. An example may be beneficial to illustrate the calculation.

For example, in FY 89 Emergency/Service was budgeted in schedule B of the A-11 Budget to consist of 47% labor, 5% materials, and 48% overhead. These percentages were then applied to the pre-determined costs shown in the year end FY 89 3A77 to calculate direct labor and direct material cost components. These costs were recorded in Appendix J. One additional assumption was made. Concerning the determination of direct labor hours, some

line items were costed using pre-determined costs based on units other than direct labor hours. In these cases, a $20/hour labor rate was assumed to determine direct labor hours because it approximated PWCSB's experience for the average rate in the line items of concern. For example, in FY 89, Job Order Number 5114697 direct labor cost was $31,476. To calculate direct labor hours, this amount was divided by the $20/hr rate. The result of 1,574 labor hours was assumed to be direct labor hours required then for that Job Order Account and recorded in Appendix J Figure 8.

Several line items of the 3A77 report were not included in the distribution costs to include Pest and Weed, Refuse and Garbage, Contract Administration, and Transportation. These items were not included because they were costed using pre-determined rates posing difficulties in deriving actual costs. Some of these costs are listed in a year end report that lists the department's indirect costs. This report is called the 5C14 report. Using cost data from the 5C14 report requires allocation of the 5C14 reported costs to each of its customers and then to each of the utility commodities. PWCSB's accounting system does not permit determination of actual costs for the predetermined rate items for each commodity at each customer site. Anyway, these line items were considered more appropriately as indirect costs, even if they can be traced to the electricity or water utility commodities, because other sites treated these costs as indirect costs. By eliminating these line items from the distribution costs, a better cost comparison could be made with the other sites. The exclusion of these costs, indirect, overhead, and accelerated costs make the unit cost data inappropriate for budgeting uses unless these exclusions are considered.

NAS's electrical distribution system costs are divided into three categories: (1) preventative maintenance, (2) repairs, and (3) capital improvements. Preventative maintenance costs were determined by using Job Order Numbers PWCSB classifies as "recurring maintenance". The remaining NAS 3A77 Job Order Numbers were divided into system repairs and capital improvements. Any Job Order account title that called for the replacement, reconstruction, installation, or rehabilitation of the electrical distribution system was regarded as a capital improvement. The following analysis will display the unit cost data for NAS's electrical distribution system sequentially in the three categories listed above. All tables below in Paragraphs two through six are constructed from Figures 8, 9, and 10 in Appendix J. The appendix and table data are subject to rounding error; however, the totals and percentages are based on unrounded inputs. NAS's recorded distribution costs are considered very reliable.

2. Total NAS Alameda Electrical Distribution System Unit Cost

Table 6 shows the total costs and energy usage associated with NAS Alameda's electrical distribution system for FY 89, 90, and 91.

TABLE 6

TOTAL NAS ALAMEDA ELECTRICAL DISTRIBUTION COSTS

	FY 89	FY 90	FY 91
Total Electrical Distribution Cost	$1,318,541	$1,647,290	$913,684
Total Energy Usage (MWH)	164,681	146,349	136,828
Electrical Distribution Unit Cost	$8.00	$11.26	$6.68

Total electrical distribution costs increased 25% from FY 89 to 90 but declined 45% between FY 90 and 91 averaging a decrease of $202,429 per year. The following breakdown of electrical distribution costs into preventative

maintenance, repairs, and capital improvements will help explain the total cost fluctuations.

3. NAS Alameda Electrical Distribution Preventative Maintenance

Job Order Numbers associated with preventative maintenance during all three fiscal years are: (1) 5114602 Maintain pier lights, (2) 5114604 PMI emergency generators, and (3) 5114606 Defense Energy Investment Support (DEIS). Table 7 displays the costs associated with these preventative maintenance numbers and shows NAS Alameda's energy usage for FY 89, 90, and 91. Costs for total preventative maintenance were the most stable of the three distribution cost categories evaluated, decreasing 8% between FY 89 and 90 and increasing 7% between FY 90 and 91. Preventative maintenance unit cost increased only 4% from FY 89 to 90 but increased 14% from FY 90 to 91. This was a result of increasing costs, primarily an increase in direct material costs in FY 91 for the DEIS account, and a continued decline in electricity usage.

TABLE 7

NAS ALAMEDA DISTRIBUTION PREVENTATIVE MAINTENANCE

	FY 89	FY 90	FY 91
Total Preventative Maintenance Cost	$251,242	$232,390	$248,808
Total Energy Usage (MWH)	164,681	146,349	136,828
Preventative Maintenance Unit Cost	$1.53	$1.59	$1.82

4. NAS Alameda Electrical Distribution System Repairs

The second component of review for the electrical distribution system is repairs. Table 8 displays the costs and energy usage associated with NAS Alameda's electrical distribution repairs. Costs in most every repair account exhibited large fluctuations from year-to-year. Repair costs at first increased 30% from FY 89 to 90 but then declined 43% from FY 90 to 91. These

fluctuating costs are presumed to be responsible for the difficulties for budgeting distribution costs.

Fluctuations in the repairs category were expected to be explained as a result of earthquake damage in FY 90. However, the job order account number 5114200 for earthquake damage in FY 90 records only $2,333 in charges. The account recording the most fluctuations was number 5114618 for minor repairs. This account increased by $251,591 from FY 89 to 90 and then decreased by $350,466 in FY 91.

TABLE 8

NAS ALAMEDA ELECTRICAL DISTRIBUTION SYSTEM REPAIRS

	FY 89	FY 90	FY 91
Total Distribution Repair Cost	$638,921	$829,050	$474,465
Total Energy Usage (MWH)	164,681	146,349	136,828
Distribution System Repair Unit Cost	$3.88	$5.66	$3.47

5. NAS Alameda Electrical Distribution Capital Improvements

Capital improvements is the last cost component reviewed for NAS Alameda's electrical distribution costs. Table 9 displays the costs and energy usage associated with NAS's electrical distribution system capital improvements. This category was also subject to large fluctuations as might be expected, particularly in an environment where this work requires structured approvals at varying authority levels. Costs increased by $157,472 or 37% from FY 89 to 90 while decreasing by $395,439 or 68% in FY 91.

The fluctuations can be explained primarily by differing scopes of projects each of the three years. Account number 5114697 was used to record the costs in FY 89 and 90 of $117,321 and $159,755 respectively for replacing the electrical distribution system associated with runway lighting but was absent

from FY 91 costs. Account number 5114681 that was used in FY 90 and 91 to record the costs associated with replacing PCB transformers was $154,284 in FY 90 but only $26,696 in FY 91. These accounts represented the largest fluctuations in capital improvement accounts.

TABLE 9

NAS ALAMEDA ELECTRICAL DISTRIBUTION CAPITAL IMPROVEMENTS

	FY 89	FY 90	FY 91
Total Capital Improvement Cost	$428,378	$585,850	$190,411
Total Energy Usage (MWH)	164,681	146,349	136,828
Capital Improvement Unit Cost	$2.60	$4.00	$1.39

6. NAS Alameda Electrical Distribution Cost Summary

The three year data of FY 89, 90, and 91 reveal how costs are distributed in maintaining the electrical distribution system. Table 10 below indicates the trends in how dollars are spent on NAS's distribution system.

TABLE 10

NAS ALAMEDA ELECTRICAL DISTRIBUTION AVERAGES (1989 - 91)

	Average FY Dollars	Average FY %	Average FY DL %	Average FY DM %	Average Contract %	Average Unit Cost
Total Electrical Distribution Cost	$1,293,172	N/A	38%	40%	22%	$8.66
Preventative Maint.	$244,147	19%	31%	16%	5%	$1.64
Distribution Repairs	$647,479	50%	63%	62%	7%	$4.34
Capital Improvement	$401,546	31%	6%	22%	88%	$2.69

Of the average annual $1.3 million spent on the electrical distribution system at NAS, the costs were distributed between preventative maintenance, capital improvements, and repairs about 20-30-50 percent respectively. Repair direct labor costs were twice the labor costs of preventative maintenance, and

repair direct material costs were approximately four times the material costs of preventative maintenance. These indicators may be helpful for better budgeting.

Unit costs for preventative maintenance, repairs, and capital improvements averaged $1.64/MWH, $4.34/MWH, and $2.65/MWH respectively indicating that repair is the area where cost efficiencies should first be concentrated. With repair costs accounting for over half the costs and given their fluctuating nature, it is easy to understand why budgeting complexities exist. The distribution costs are limited to the assumptions and treatment of the data described earlier in this chapter; some costs PWCSB usually uses to cost its services were excluded from the data. Of the total distribution costs over the three year period, direct labor was 37% of the costs, direct materials 40%, other direct costs 1%, and contracts 22%.

C. NAS ALAMEDA ELECTRICITY PROCUREMENT AND DISTRIBUTION COST COMBINED

Table 11 combines total electricity procurement costs from Table 2 with the total electrical distribution costs from Table 6. The unit cost displayed in Table 11 includes all direct costs for procuring and maintaining the electrical distribution system at NAS Alameda. On a unit cost basis, using MWH as the base, costs increased by 5% from FY 89 to 90 and by 4% from FY 89 to 91. Total costs decreased by $1,807,562 or 14% over the three year period. Fiscal year total costs decreased $829,020 or 6% between FY 89 and 90 and decreased $978,542 or 8% between FY 90 and 91. Annual savings of more than $900,000 were achieved mostly because of decreased consumption.

Over the three year period, procurement costs accounted for 89% of the total direct costs. Electrical distribution costs at NAS averaged $8.66/MWH over the

three year period while NAS electrical procurement costs averaged $71.88/MWH. Savings in distribution costs will have less impact than will procurement costs because of the relative weighting of each of the two cost components. A 1% savings in procurement cost is nine times more beneficial than a 1% savings in distribution costs. Cost savings effort might deserve nine times the effort in procurement area than in the distribution area.

TABLE 11

NAS ALAMEDA COMBINED PROCUREMENT AND DISTRIBUTION COSTS

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$11,584,050	$10,426,281	$10,181,345
Total Electrical Distribution Cost	$1,318,541	$1,647,290	$913,684
Total Energy Usage (MWH)	164,681	146,349	136,828
Total Electricity Procurement and Distribution Unit Cost	$78.35	$82.50	$81.09

D. NAS ALAMEDA WATER PROCUREMENT COSTS

1. Data Collection

PWCSB procures NAS Alameda's water from the East Bay MUD. Water procurement costs and water usage were obtained from the actual billings of East Bay MUD. The water procurement costs for NAS are exhibited in Appendix J Figures 11, 12, and 13. Water charges and usage were validated with internal PWCSB spreadsheet data identical to the method used for electricity. However, the actual billings received for water differed from those received and reviewed for electricity.

Unlike electricity billings, water billings often included a credit to offset prior penalty charges levied by the utility company. To compensate and determine the correct monthly charges, the prevailing rate structure

corresponding with no applied penalty charges was multiplied by the actual monthly usage. This method reflected the amounts eventually paid for the water and ensured the charges actually levied were associated with their usage.

NAS's water charges and usage data will next be analyzed on a total cost and usage basis. Unlike electricity charges that have various elements, water bills only apply a single rate unless stair step penalty charges are applied. Therefore only total cost and usage are displayed below. The appendix and table data are subject to rounding error; however, the totals and percentages are based on unrounded inputs. Figures 11, 12, and 13, in Appendix J are used to construct the tables below.

2. Total NAS Alameda Water Charges and Usage

Table 12 below displays NAS Alameda's water procurement costs and consumption data. Total water procurement costs for NAS decreased $200,254 or 23% between FY 89 and 90. Part of this large fluctuation in costs is associated with a 7% decrease in water usage. The remainder of the decrease in costs is associated with the rate structure for FY 90. While FY 89 rates ranged from $0.88 to $1.05 a unit (748 gallons), FY 90 rates ranged from $0.71 to $0.91 a unit. Procurement costs increased between FY 90 and 91 by 32%. This increase is partly explained by an increase in usage of 7% and an increase in the rate structure to a high of $1.18 a unit in FY 91.

TABLE 12

TOTAL NAS ALAMEDA WATER PROCUREMENT

	FY 89	FY 90	FY 91
Total Water Procurement Cost	$857,076	$656,822	$869,275
Total Water Usage (Thousand/Gal)	650,097	606,642	650,421
Water Procurement Unit Cost	$1.32	$1.08	$1.34

E. NAS ALAMEDA WATER DISTRIBUTION COSTS

1. Data Collection

NAS Alameda's water distribution system is maintained by PWCSB. The water distribution costs for NAS are displayed in Appendix J Figures 14, 15, and 16 by Job Order Number. These costs were obtained from report 3A77 using the same methods and assumptions as used for the electrical distribution costs discussed earlier. Distribution costs will be exhibited using the four categories (1) total water distribution system, (2) preventative maintenance, (3) repairs, and (4) capital improvements. The appendix and table data are subject to rounding error; however, the totals and percentages are based on unrounded inputs. Figures 14, 15, and 16, in Appendix J are used to construct the tables below in paragraphs two through six.

2. Total NAS Alameda Water Distribution System Unit Cost

Table 13 shows the total costs and usage for NAS Alameda's water distribution system during FY 89, 90, and 91.

TABLE 13

TOTAL NAS ALAMEDA WATER DISTRIBUTION COSTS

	FY 89	FY 90	FY 91
Total Water Distribution Cost	$1,568,355	$390,747	$824,153
Total Water Usage (Thousand/Gal)	650,097	606,642	650,421
Water Distribution Unit Cost	$2.41	$0.64	$1.27

Total water distribution costs in Table 13 show large fluctuations in costs from year-to-year. Between FY 89 and 90 total distribution costs decreased $1,177,608 or 75%. Total distribution costs increased $433,406 or 111% between FY 90 and 91. These large fluctuations from year-to-year are explained

in the breakdown of distribution costs into preventative maintenance, repairs, and capital improvements provided in paragraphs 3, 4, and 5 below.

3. NAS Alameda Water Distribution Preventative Maintenance

The Job Order Numbers associated with preventative maintenance during all three fiscal years are: (1) 5154514 Service water distribution system, (2) 5154604 PMI water distribution system, and (3) 5154606 DEIS. Table 14 displays the costs associated with these preventative maintenance numbers and shows NAS's water usage for FY 89, 90, and 91. Unit costs for preventative maintenance averaged $0.05 a thousand gallons for the three fiscal years. Preventative maintenance costs were the most stable of the three distribution categories examined.

TABLE 14

NAS ALAMEDA WATER DISTRIBUTION PREVENTATIVE MAINTENANCE

	FY 89	FY 90	FY 91
Preventative Maintenance Cost	$25,321	$36,517	$35,527
Total Water Usage (Thousand/Gal)	650,097	606,642	650,421
Preventative Maintenance Unit Cost	$0.04	$0.06	$0.05

4. NAS Alameda Water Distribution System Repairs

Table 15 displays the costs and water usage associated with NAS Alameda's water distribution repairs. Costs in this category decreased significantly from FY 89 to 90 by a total of $183,475. The Job Order Number recording the most fluctuation was number 5154618 for minor repairs. The Minors account is a standing Job Order account which accumulates costs for work that includes no engineering, no more than three trades, costs no more than $3,000 for materials, takes no longer than three months to complete, and no more than 80 man-hours to complete. Minor repairs decreased $194,189

between FY 89 and 90 accounting for more than the decrease in water distribution repair costs. Repair costs increased $14,138 or 5% between FY 90 and 91.

TABLE 15

NAS ALAMEDA WATER DISTRIBUTION SYSTEM REPAIRS

	FY 89	FY 90	FY 91
Total Water Distribution Repair Cost	$446,358	$262,883	$277,021
Total Water Usage (Thousand/Gal)	650,097	606,642	650,421
Water Distribution Repair Unit Cost	$0.69	$0.43	$0.43

5. NAS Alameda Water Distribution Capital Improvements

Table 16 displays the costs and water usage associated with NAS Alameda's water distribution system capital improvements.

TABLE 16

NAS ALAMEDA WATER DISTRIBUTION CAPITAL IMPROVEMENTS

	FY 89	FY 90	FY 91
Total Capital Improvement Cost	$1,096,676	$91,347	$511,605
Total Water Usage (Thousand/Gal)	650,097	606,642	650,421
Capital Improvement Unit Cost	$1.69	$0.15	$0.79

Large variations exist in capital improvements reflecting the spending and execution nature of capital improvement projects. Phase 1 and 2 of a water line replacement project was responsible for over 86% of the capital improvement costs in the three year period. Unit costs fluctuated about a mean of $0.92 by 84%.

6. NAS Alameda Water Distribution Cost Summary

A capital improvement project which replaced a portion of the water distribution system accounted for the largest portion of all costs on the NAS water distribution system, 61%, as can be seen below in Table 17.

TABLE 17

NAS ALAMEDA WATER DISTRIBUTION AVERAGES

	Average FY Dollars	Average FY %	Average FY DL %	Average FY DM %	Average Contract %	Average Unit Cost
Total Water Distribution Cost	$927,752	NA	31%	28%	41%	$1.46
Preventative Maint.	$32,455	3.5%	10%	1%	0.5%	$0.05
Distribution Repairs	$328,754	35.4%	71%	41%	5%	$0.52
Capital Improvement	$566,543	61.1%	19%	58%	94.5%	$0.89

Distribution costs were divided between preventative maintenance, repairs, and capital improvements by about 4 - 36 - 60 percents respectively. Repairs were the most demanding distribution category for direct labor accounting for 71% of total distribution labor costs while capital improvements were most demanding for direct materials accounting for 58% of total direct material costs. Repair labor costs were about seven times greater than preventative maintenance labor costs for the three year period. Preventative maintenance costs were the most consistent of the three categories. Contracting accounted for about 41% of all work. Of the other total distribution costs, direct labor represented 31% of the costs and direct material represented 28%. Unit cost for preventative maintenance, repairs, capital improvements over the three year period were $0.05, $0.52, and $0.89 for a total of about $1.46/KGAL. The distribution costs are limited to the assumptions and treatment of the data described earlier in Paragraph B1; some costs PWCSB usually uses to cost its services were excluded from the data.

F. NAS ALAMEDA WATER PROCUREMENT AND DISTRIBUTION COST COMBINED

Table 18 combines total water procurement costs from Table 12 with the total water distribution costs from Table 13.

TABLE 18

NAS ALAMEDA COMBINED PROCUREMENT AND DISTRIBUTION COSTS

	FY 89	FY 90	FY 91
Total Water Procurement Cost	$857,076	$656,822	$869,275
Total Water Distribution Cost	$1,568,355	$390,747	$824,153
Total Water Usage (Thousand/Gal)	650,097	606,642	650,421
Total Water Procurement and Distribution Unit Cost	$3.73	$1.73	$2.60

Over the three year period, procurement and distribution costs were split broadly 45/55 percent. The implication is that management focus should be directed to both areas equally, but large capital improvement investments inflated distribution costs over this period. Conservation efforts to reduce procurement cost will result in the largest cost savings initially. As with electricity, repair labor efficiencies can result in the largest distribution savings because the repair effort is the largest in-house distribution cost component. Total water procurement and distribution costs over the three periods were $2.71/KGAL, $1.25 for procurement and $1.46 for distribution.

Both electrical and water procurement and distribution costs have been presented for NAS Alameda. Each type of cost has been broken into components to better identify cost drivers. None of the costs presented include indirect or overhead costs. Direct labor costs do not include acceleration costs. Some distribution costs normally used by PWCSB for budgeting purposes are also not included. These costs included, Pest and Weed, Refuse and Garbage,

Contract administration, and Transportation. For comparison, non-DoD site data must also be presented. Each site's data are sequentially displayed in the following chapter.

V. NON-DOD SITE DATA AND NAS COMPARISON

In this chapter the three non-DoD sites unit cost data for electricity and water will be examined and compared with the unit costs determined for NAS from Chapter IV. The approach and assumptions used for collection of the data are presented. To the extent the data permits, unit costs in the two primary categories of (1) procurement costs and (2) distribution costs will be examined for FY 89, 90, and 91. Following the successive individual Site analyses, selected data from each site will be compared with NAS data.

A. SITE 1 ELECTRICITY PROCUREMENT

1. Data Collection and Billing Structure

Site 1's electricity is procured from PG&E. The procurement costs for Site 1's electricity are displayed in Appendix K Figures 17, 18, and 19. The procurement costs shown were all obtained from primary archival documents, the actual PG&E billings. The billings were cross referenced against internal spreadsheets used for consumption and cost tracking. Site 1's electricity procurement costs are considered highly reliable.

The PG&E billings separate procurement costs into five basic elements: (1) customer charge, (2) demand charge, (3) energy charge, (4) adjustment energy charge, and (5) surcharge. Each of these is defined below.

The <u>customer charge</u> is a flat monthly fee that ranged from $100 in FY 89 to $220 in FY 91. The <u>demand charge</u> for Site 1 includes two types of charges. The first demand charge is a maximum peak period per kilowatt (KW) unit charge that applies to the maximum demand during the month's peak hours.

Peak hours are defined on a seasonal basis. The second demand charge is a maximum demand per KW unit charge applied to the maximum demand occurring at any time during the month. The energy charge is levied per KW and is a combination of charges that vary for seasons, peak, partial-peak, and off-peak periods. The adjustment energy charge is also a combination of charges that vary for seasons, peak, partial peak, and off-peak periods. It is levied to recoup PG&E direct variable costs. Lastly, a surcharge is applied to the total bill to generate state revenue.

Site 1's electricity charges will next be broken into four components for examination: (1) total charges and usage, (2) demand charges, (3) energy charges, and (4) adjustment energy charges. This approach is similar to that used for NAS in Chapter IV. All tables in Paragraphs 2 through 5 below are constructed from Appendix K Figures 17, 18, and 19. The appendix and table data displayed are subject to rounding error; however, the totals and percentages are based on unrounded inputs.

2. Total Site 1 Electricity Charges and Usage

Site 1's total charges and usage is presented first in Table 19. Site 1's electricity usage increased from FY 89 to 90 but then decreased by FY 91. Although electricity consumption decreased overall in FY 91, procurement charges increased steadily during the years under review. FY 90 total procurement charges increased 9% from FY 89. The increase in charges is partly explained by an increase in consumption and increases in the rate schedule. Total procurement charges increased 6% between FY 90 and FY 91. This increase was entirely due to increases in the rate schedule because

electricity usage declined during this period. Unit costs increased 7% from FY 89 to 90 and 10% from FY 90 to 91.

TABLE 19

TOTAL SITE 1 ELECTRICITY PROCUREMENT

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$8,162,111	$8,926,597	$9,470,261
Total Electricity Usage (MWH)	137,352	140,112	135,240
Electricity Procurement Unit Cost	$59.42	$63.71	$70.03

3. Site 1 Demand Charges and Usage

The second component of procurement costs reviewed is demand charges. Table 20 shows Site 1's demand charges and usage data for FY 89, 90, and 91.

TABLE 20

SITE 1 DEMAND CHARGES

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$8,162,111	$8,926,597	$9,470,261
Total Demand Cost	$1,254,729	$1,405,981	$1,539,035
Total Demand Usage (KW)	265,128	267,353	253,649
Demand Percentage of Total Cost	15.37%	15.75%	16.25%
Demand Average Unit Cost (KW)	$4.73	$5.26	$6.07

Demand charges represented a fairly constant percentage of total charges averaging about 16% per year. On a unit cost basis, costs increased $0.53 from FY 89 to 90 and by $0.81 from FY 90 to 91. Site 1's demand charges and NAS's peak demand charges should not be compared. Whereas Site 1's demand charges have two factors, as discussed previously, NAS's peak demand charge is applied only to the highest demand during the month.

4. Site 1 Energy Charges and Usage

Table 21 shows Site 1's energy charges, the third component to be reviewed. Site 1's energy charges decreased from representing approximately 32% of total charges in FY 89 to representing only 8% in FY 91. This was primarily due to changes in the rate schedule. Total energy costs decreased $1,088,982 between FY 89 and 90 and $732,608 between FY 90 and 91. Unit costs for energy charges decreased $13.17 per MWH or by almost 70% during the three years examined.

TABLE 21

SITE 1 ENERGY CHARGES

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$8,162,111	$8,926,597	$9,470,261
Total Energy Cost	$2,600,560	$1,511,578	$778,970
Total Energy Usage (MWH)	137,352	140,112	135,240
Energy Percentage of Total Cost	31.86%	16.93%	8.23%
Average Energy Unit Cost (MWH)	$18.93	$10.79	$5.76

5. Site 1 Adjustment Energy Charges and Usage

The fourth and final component of procurement charges for Site 1 is the adjustment charges. Table 22 shows Site 1's adjustment energy charges and usage data for FY 89, 90, and 91. Most of the increases in PG&E's rate schedule was in adjustment energy charges. Unit costs for Site 1 increased $21.52 over the three year period accounting for a 69% increase in unit cost. Annual adjustment energy charges increased $2,844,701 during the three year period and from representing 52% of total procurement charges in FY 89 to representing 75% of those charges by FY 91.

TABLE 22

SITE 1 ADJUSTMENT ENERGY CHARGES

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$8,162,111	$8,926,597	$9,470,261
Total Adjustment Energy Cost	$4,278,389	$5,979,465	$7,123,090
Total Energy Usage (MWH)	137,352	140,112	135,240
Adjustment Energy % of Total Cost	52.42%	66.98%	75.22%
Average Adjust. Energy Unit Cost	$31.15	$42.68	$52.67

6. Site 1 Electricity Procurement Cost Summary

Although electricity usage fluctuated from year-to-year, unit costs for total electricity procurement increased at an average annual rate of 9%. Changes in the rate schedule shifted adjustment energy charges from 52% to 75% of the total procurement charges by FY 91. While peak demand charges remained fairly constant at approximately 16% of the total bill, energy charge's contribution to the total bill shifted downward representing less than 10% of total charges in FY 91. Consumption trends were fairly stable with a distribution of 12 - 34 - 54 percents for peak, partial peak, and off - peak respectively. The average annual unit cost for the three year period is $64.39/MWH with a monthly high of $88.34/MWH and a low of $49.62/MWH. The reader is cautioned to recall these costs are based on one of Site 1's accounts representing the majority of usage. Site 1's electrical distribution costs will be examined next after reviewing data collection methods and assumptions.

B. SITE 1 ELECTRICAL DISTRIBUTION COSTS

1. Data Collection

The electrical distribution costs for Site 1 are displayed in Appendix K Figures 20, 21, and 22. Appendix K includes electrical distribution costs for FY

90, 91, and 92; because distribution costs were not available for FY 89, but they were available for FY 92. For comparison purposes; however, only the costs in FY 90 and 91 will be presented in this thesis. The costs reported for FY 92 are displayed in the appendix because it is useful for data validity and trend recognition. The inclusion of FY 92 data in the appendix also permits future comparisons that PWCSB may conduct.

Site 1's accounting system is similar to PWCSB's in the usage of job numbers to track distribution costs. However, unlike PWCSB's 3A77 Job Order Cost report that provides a breakdown of costs into direct labor, direct material, and contract components, the cost data for Site 1's electrical distribution system were obtained on a total cost per job account basis. The site provided the year end total costs of all accounts broken into a direct labor and material components. The total costs of each account were broken down into direct labor and direct material components based on the year end breakdown of labor and material percentage provided by the site. Additionally, 25% of the direct labor amount was subtracted to discount employee benefits and 2.9% of the direct labor amount was further subtracted to discount applied overhead. These percentages were also supplied by Site 1.

For comparison purposes some cautions must be noted. Site 1 completed a three year replacement of most of the electrical distribution system costing approximately $14 million. Scheduled construction began in 1986 and terminated about March 1991. These costs are not included as capital improvements distribution costs in the appendix data. The costs for preventative maintenance, repairs, and capital improvements shown in Appendix K reflect lower distribution costs than otherwise would be incurred with an older system

because the existence of their new system caused cancellation of maintenance work. Site 1 is also underfunded by about 50 - 70% by its regulatory budgetary authority. Repair and maintenance costs could be skewed smaller because of this underfunding.

Because capital improvement costs, other than the $14 million system upgrade, were zero for FY 89 and 90; distribution costs are exhibited below using only two categories— preventative maintenance and repair costs. The data is considered reliable.

2. Total Site 1 Electrical Distribution System Unit Cost

Table 23 shows the costs and energy usage associated with Site 1's electrical distribution system for FY 90 and 91. Site 1's total distribution costs declined 29% between FY 90 and 91. From discussions with Site 1 individuals, the decline in repair costs for FY 91 was a result of delaying or shifting repair work to the capital improvement project under construction. Costs for FY 92 are included in Appendix K Figure 22 and reflect an increase in repair costs after the electrical distribution rework was completed.

TABLE 23

TOTAL SITE 1 ELECTRICAL DISTRIBUTION COSTS

	FY 90	FY 91
Total Electrical Distribution Cost	$336,564	$239,957
Total Energy Usage (MWH)	140,112	135,240
Electrical Distribution Unit Cost	$2.40	$1.77

3. Site 1 Electrical Distribution Preventative Maintenance

Table 24 shows the preventative maintenance costs and energy usage associated with Site 1's electrical distribution system for FY 90 and 91. Preventative maintenance costs decreased significantly resulting in costs less

than $1,000 in FY 91 and 92. This was ascertained through discussions to be a result of two factors. First, it was a result of shifting and delaying work to the capital improvement project. Second, it was a result of changes in the way preventative maintenance work is performed. Instead of the more traditional approach of using time as the basis of intervals between PM checks and inspections for taking items apart, only the more essential maintenance was performed. Essential preventative maintenance included items such as lubrication and filter changes at the recommended intervals; however, it did not include equipment disassembly for inspection purposes.

TABLE 24

SITE 1 DISTRIBUTION PREVENTATIVE MAINTENANCE

	FY 90	FY 91
Total Preventative Maintenance Cost	$10,215	$435
Total Energy Usage (MWH)	140,112	135,240
Preventative Maintenance Unit Cost	$0.07	$.003

4. Site 1 Electrical Distribution System Repairs

Table 25 shows the costs and energy usage associated with Site 1's electrical distribution system repairs.

TABLE 25

SITE 1 ELECTRICAL DISTRIBUTION SYSTEM REPAIRS

	FY 90	FY 91
Total Distribution Repair Cost	$326,350	$239,522
Total Energy Usage (MWH)	140,112	135,240
Distribution System Repair Unit Cost	$2.33	$1.77

The predominate distribution cost for Site 1 was in the area of repairs. Repair costs represented approximately 97% of the total distribution costs in FY 90 and greater than 99% in FY 91. Repair costs continued to represent over

99% of the total costs in FY 92 as shown in Appendix K Figure 22. Repair costs did decline between FY 90 and 91 but increased in FY 92. Again this was mainly a result of the new electrical distribution system.

C. SITE 1 ELECTRICITY PROCUREMENT AND DISTRIBUTION COST COMBINED

Table 26 combines total electricity procurement costs from Table 19 with the total electrical distribution costs from Table 23. The procurement account analyzed was substantial in that distribution costs to the peripheral systems network relating to all other procurement accounts was ascertained to be negligible. Data is therefore reliable for the determination of unit costs but total procurement costs and usage are understated because of the inclusion of only one account in the data. The result of the data indicates increasing electricity procurement charges resulted in the total annual unit cost for distribution and procurement rising $5.69 per MWH by FY 91. This represents a 9% increase in unit costs during a period of declining energy usage and maintenance (preventative maintenance and repair).

Distribution costs represent about 3% of the total costs for Site 1 whereas it represents about 10% for NAS. The newer system at Site 1 probably reduced distribution costs significantly. Procurement costs represent nearly the entire cost over the three years for Site 1. If the system upgrade costs would have been added to the distribution costs as capital improvements, the results would have been different. Distribution costs for FY 90 and 91 would have been $2,900,106 and $2,312,023 respectively on a prorata basis. Distribution costs then would have represented about 22% of the total costs during the two year period, increasing unit distribution costs by $17.59 (prorata basis). A prorata

basis assumes the construction cost is divided evenly over 69 months and applied over 21 months of construction in FY 90 and 91 for the numerator while actual monthly electricity usage during the 21 months of construction in FY 90 and 91 is used for the denominator.

TABLE 26

SITE 1 COMBINED PROCUREMENT AND DISTRIBUTION COSTS

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$8,162,111	$8,926,597	$9,470,261
Total Electrical Distribution Cost	N/A	$336,564	$239,957
Total Energy Usage (MWH)	137,352	140,112	135,240
Total Electricity Procurement and Distribution Unit Cost	N/A	$66.11	$71.80

D. SITE 1 WATER PROCUREMENT COSTS

1. Data Collection

Site 1's water is procured from the East Bay MUD. The water procurement costs for Site 1 are displayed in Appendix K Figures 23 and 24. The procurement costs shown were obtained from secondary archival documents (internal spreadsheets) because the actual billings were not available. Furthermore, water procurement data were available for only FY 90 and 91.

Site 1's internal spreadsheet data for FY 90 recorded penalty charges on a monthly basis. Therefore this information was used in the form it was received and recorded in Appendix K Figure 23. In FY 91, however, penalty charges were not recorded on a per month basis but as a yearly total. FY 91 penalty charges were therefore divided into monthly amounts based on a weighted average of monthly water usage. The resultant amounts are shown in Appendix K Figure 24.

Site 1's water charges and usage data will next be analyzed on a total cost basis for comparison with NAS data. The appendix and table data are subject to rounding error; however, the totals are based on unrounded inputs. The water procurement data are considered reliable.

2. Total Site 1 Water Charges and Usage

Table 27 shows Site 1's water procurement costs and usage data for FY 90 and 91. Although water usage declined by 10% from FY 90 to 91, total water procurement charges increased $100,743 or by 15%. The major cause of this increase was drought penalty charges levied by East Bay MUD. On a unit cost basis (KGAL), costs increased 28% from FY 90 to 91. Average unit cost for the two year period is $1.44.

TABLE 27

TOTAL SITE 1 WATER PROCUREMENT

	FY 90	FY 91
Total Water Procurement Cost	$683,941	$784,684
Total Water Usage (Thousand/Gal)	538,980	483,186
Water Procurement Unit Cost	$1.27	$1.62

E. SITE 1 WATER DISTRIBUTION COSTS

1. Data Collection

The water distribution system costs for Site 1 are displayed in Appendix K Figures 25, 26, and 27. Appendix K includes water distribution costs for FY 90, 91, and 92 because distribution costs for FY 89 were unavailable. For comparison purposes, only the costs for FY 90 and 91 will be used ; however, the costs for FY 92 are displayed for further trend analysis in Appendix J.

Water distribution costs were obtained on a total cost per job account basis. Total costs were broken into direct labor and direct material components using the same information and assumptions used for the electrical distribution costs. Water distribution costs will next be displayed using the four categories: (1) total water distribution system, (2) preventative maintenance, (3) repairs, and (4) capital improvements. The appendix and table data are subject to rounding error; however, the totals are based on unrounded data. The water distribution data is considered reliable.

1. Total Site 1 Water Distribution System Unit Cost

Table 28 shows the total costs and usage for Site 1's water distribution system for FY 90 and 91. Total water distribution costs decreased significantly from FY 90 to FY 91. The decrease of $127,628 in total costs represented a decline of 42%. FY 92 water distribution costs are displayed in Appendix K Figure 27 and reflect a continuance of significantly lower distribution costs. During this period, unlike the electrical distribution system, no major capital improvements were being conducted on the water system.

TABLE 28

TOTAL SITE 1 WATER DISTRIBUTION COSTS

	FY 90	FY 91
Total Water Distribution Cost	$303,599	$175,971
Total Water Usage (Thousand/Gal)	538,980	483,186
Water Distribution Unit Cost	$0.56	$0.36

2. Site 1 Water Distribution Preventative Maintenance

Table 29 shows the costs and water usage associated with Site 1's water distribution preventative maintenance. Water distribution preventative maintenance cost was an insignificant portion of total distribution costs in FY 90

and no costs were recorded in FY 91 or 92 as shown in Appendix K Figure 27. The same preventative maintenance practices as described previously for the electrical distribution system were employed in the maintenance of the water system. However, with no preventative maintenance costs recorded in FY 91 or 92, even "essential" maintenance would appear to have been excluded. A longer evaluation period would be required to ascertain the relative cost advantage or disadvantage from performing no preventative maintenance.

TABLE 29

SITE 1 WATER DISTRIBUTION PREVENTATIVE MAINTENANCE

	FY 90	FY 91
Preventative Maintenance Cost	$1,935	$0
Total Water Usage (Thousand/Gal)	538,980	483,186
Preventative Maintenance Unit Cost	$.004	$0

3. Site 1 Water Distribution System Repairs

Table 30 shows the costs and water usage associated with Site 1's water distribution repairs.

TABLE 30

SITE 1 WATER DISTRIBUTION SYSTEM REPAIRS

	FY 90	FY 91
Total Water Distribution Repair Cost	$299,479	$172,284
Total Water Usage (Thousand/Gal)	538,980	483,186
Water Distribution Repair Unit Cost	$0.55	$0.36

Water distribution repair costs declined between FY 90 and 91 and remained low during FY 92 as well. Like electrical distribution repair costs, water distribution repairs represented approximately 98% of the total distribution costs during all three fiscal years.

4. Site 1 Water Distribution System Capital Improvements

Table 31 shows the costs and water usage associated with Site 1's water distribution system capital improvements. Site 1's distribution capital improvement costs were also an insignificant portion of total distribution costs. Appendix K Figures 25, 26, and 27 reflect capital improvement costs of less than 1% of the total distribution costs for FY 90 and 92, increasing marginally to 2% in FY 91.

TABLE 31

SITE 1 WATER DISTRIBUTION CAPITAL IMPROVEMENTS

	FY 90	FY 91
Total Capital Improvement Cost	$2,184	$3,687
Total Water Usage (Thousand/Gal)	538,980	483,186
Capital Improvement Unit Cost	$.004	$.008

F. SITE 1 WATER PROCUREMENT AND DISTRIBUTION COST COMBINED

Table 32 combines total water procurement costs from Table 27 with the total water distribution costs from Table 28.

TABLE 32

SITE 1 COMBINED PROCUREMENT AND DISTRIBUTION COSTS

	FY 90	FY 91
Total Water Procurement Cost	$683,941	$784,684
Total Water Distribution Cost	$303,599	$175,971
Total Water Usage (Thousand/Gal)	538,980	483,186
Total Water Procurement and Distribution Unit Cost	$1.83	$1.99

Over the two year period, procurement and distribution costs were split broadly 75/25 percent whereas NAS was 50/50 percent. Large capital improvements inflated distribution costs for NAS over this period. By combining

Site 1's procurement and distribution costs it can be seen that unit costs per KGAL increased 9% from FY 90 to FY 91. The major factor for this increase in unit costs was the water procurement penalty charges incurred in FY 91. Significantly lower water distribution costs in FY 91 helped to offset this increase in procurement costs.

G. SITE 2 ELECTRICITY PROCUREMENT COSTS

1. Data Collection

Site 2's electricity is procured from a cogenerator producer. Site 2 uses PG&E as a reserve supplier. The procurement costs for Site 2's electricity are displayed in Appendix L Figure 28. The procurement costs shown were obtained from secondary archival documents (internal spreadsheets) because the actual billings were not available. Additionally, electricity procurement data were only available for FY 90 and 91.

Site 2's internal spreadsheets recorded total energy usage and charges on a monthly basis. Information for peak demand, energy demand, fuel adjustment, customer charges, or surcharges could not be obtained. For comparison with NAS's data, Site 2's data will next be examined from a total procurement cost perspective. Site 2's procurement data are considered highly reliable.

2. Total Site 2 Electricity Charges and Usage

Table 33 shows Site 2's total electricity procurement charges and usage data for FY 90 and 91. Site 2 provides some facilities and utilities to the cogenerator. Although Site 2 negotiates rates with the cogenerator producer in an open market atmosphere, Site 2 potentially gains favorable rates. The extent of any potential favorability in rate setting because of contractual or other

agreements could not be determined. If no favorability is inherent in the rate structure, Site 2 has a highly favorable procurement arrangement considering cost alone. The cogenerator feeds 45% of its output to Site 2 at a unit cost in the aggregate as shown below, average about $53.16/MWH. Most profits though are obtained from sales of the other 55% of output to PG&E.

TABLE 33

TOTAL SITE 2 ELECTRICITY PROCUREMENT

	FY 90	FY 91
Total Electricity Procurement Cost	$8,039,162	$8,015,585
Total Electricity Usage (MWH)	150,767	151,230
Electricity Procurement Unit Cost	$53.32	$53.00

H. SITE 2 ELECTRICAL LABOR DISTRIBUTION COSTS

1. Data Collection

Only distribution labor costs for preventative maintenance and repair in the aggregate could be determined from the accounting data Site 2 presented. To arrive at labor costs, assumptions were made which will be provided shortly. Material cost data could not be determined because accounting data costs material when procured— not when issued. Material is put into inventory until used. Site 2 was unable to account for material used. Procurement data for materials were too inconsistent too be considered reliable under an assumption that material is used in some proportion to procurement.

Capital improvement cost data were submitted too late for inclusion in this analysis. Generally though, capital improvements are amortized over 15 years and averaged about $9 million for FY 87, 88, 89, and 90. Amortized systems included $925,000 on the electrical system and $630,000 on the water

system for FY 90. Capital improvement costs include making connections from the distribution system to new buildings whereas the Navy usually does not incur these costs.

Labor costs were determined by using labor data from the High Voltage Shop accounts. Manpower averages 6.17 through the year totaling 12,834 hours. Site 2 budgeted in FY 93 that 79% of the labor was billable after accounting for holidays, vacations, coffee breaks, etc. Straight time is budgeted for 73% or about $202,000 and overtime is budgeted for 6% or about $25,000. These amounts total roughly $225,000. The High Voltage Shop operating labor account recorded $256,102 for wage expenses in FY 91 appeared reasonable as compared to the budgeted data. This actual cost was applied to the 73% and 6% assumptions. FY 89 and 90 data were not available. Assumptions used to arrive at base wage rate labor make the data reliable only for broad comparison purposes.

2. Site 2 Electrical Distribution System Labor Unit Cost

Table 34 shows the total labor costs and energy usage associated with Site 2's electrical distribution system for FY 91.

TABLE 34

SITE 2 ELECTRICAL DISTRIBUTION LABOR COSTS

	FY 91
Electrical Distribution Labor Cost	$202,321
Total Energy Usage (MWH)	151,230
Electrical Distribution Labor Unit Cost	$1.34

The $202,321 cost was calculated based on the assumptions described in Paragraph 1 above. This cost is for labor only and does not include costs for materials and contract work. This data are provided in this section but is not

compared with the other sites in this chapter because it does not fit within the comparison framework of this chapter. Instead this labor unit cost will be compared in Chapter VI when unit costs are further broken down into direct labor, direct material, and contract components.

I. SITE 2 ELECTRICITY PROCUREMENT AND DISTRIBUTION LABOR COST COMBINED

Table 35 combines total electricity procurement costs from Table 33 with the electrical distribution labor costs from Table 34. Electrical distribution labor costs were only available for FY 91 therefore only a FY 91 combined unit cost could be determined. Additionally, this cost will not be compared in this chapter but will be analyzed and compared in Chapter VI. Again the distribution cost data includes only labor costs.

TABLE 35

SITE 2 COMBINED PROCUREMENT AND LABOR DISTRIBUTION COSTS

	FY 90	FY 91
Total Electricity Procurement Cost	$8,039,162	$8,015,585
Electrical Distribution Labor Cost	N/A	$202,321
Total Energy Usage (MWH)	150,767	151,230
Total Electricity Procurement and Distribution Labor Unit Cost	N/A	$54.34

J. SITE 2 WATER PROCUREMENT COSTS

1. Data Collection

Site 2's water is procured from a city source. The water procurement costs for Site 2 are displayed in Appendix L Figure 29. The procurement costs shown were obtained from secondary archival documents (internal spreadsheets)

because the actual billings were not available. Furthermore, water procurement data were only available for FY 90 and 91.

Information recorded on internal company spreadsheets only recorded total charges and usage data. No further information was provided to delineate the possibility of penalty charges or for further subdivision of costs for comparison. Therefore, Site 2's water charges and usage data will next be analyzed on a total cost basis for comparison with NAS data. The appendix and table data are subject to rounding error; however, the totals are based on unrounded inputs. Site 2's water procurement data is considered reliable.

2. Total Site 2 Water Charges and Usage

Table 36 shows Site 2's water procurement costs and usage data for FY 90 and 91. Table 36 unit costs reflect the likelihood of penalty charges for water usage in FY 90. Unit costs declined 52% while usage declined only 14% between FY 90 and 91. The average annual water procurement unit cost over the two year period was $1.77.

TABLE 36

TOTAL SITE 2 WATER PROCUREMENT

	FY 90	FY 91
Total Water Procurement Cost	$2,483,652	$1,023,513
Total Water Usage (Thousand/Gal)	1,037,619	888,795
Water Procurement Unit Cost	$2.39	$1.15

K. SITE 2 WATER LABOR DISTRIBUTION COSTS

1. Data Collection

As was the case for Site 2's electrical distribution costs, only distribution labor costs in the aggregate could be determined from the accounting data Site 2

presented. Lacking site direction, the same assumption for 79% of actual cost recorded in the Water Systems Shop operating labor account for wage expenses was utilized. This again was based on Site 2's FY 93 budgeting for 73% straight time and 6% overtime. FY 89 and 90 data were not available. Distribution cost data are considered useful only for broad comparison purposes.

2. Site 2 Water Distribution System Labor Unit Cost

Table 37 shows the total labor costs and usage for Site 2's water distribution system during FY 91. The $109,118 cost shown in Table 37 is for labor only and does not include costs for direct materials or contract work. The data is displayed now to provide the information available from Site 2. The water distribution labor cost will be compared with the other sites in Chapter VI when a direct labor unit cost comparison is provided.

TABLE 37

SITE 2 WATER DISTRIBUTION LABOR COSTS

	FY 91
Water Distribution Labor Cost	$109,118
Total Water Usage (Thousand/Gal)	888,795
Water Distribution Labor Unit Cost	$0.12

L. SITE 2 WATER PROCUREMENT AND DISTRIBUTION LABOR COST COMBINED

Table 38 combines total water procurement costs from Table 36 with the water distribution labor costs from Table 37. A combined water procurement and distribution labor unit cost could only be determined for FY 91 due to the availability of distribution cost data. This unit cost data will be compared in Chapter VI when site distribution labor unit costs are examined.

TABLE 38

SITE 2 COMBINED PROCUREMENT AND DISTRIBUTION LABOR COSTS

	FY 90	FY 91
Total Water Procurement Cost	$2,483,652	$1,023,513
Water Distribution Labor Cost	N/A	$109,118
Total Water Usage (Thousand/Gal)	1,037,619	888,795
Total Water Procurement and Distribution Labor Unit Cost	N/A	$1.27

M. SITE 3 ELECTRICITY PROCUREMENT COSTS

1. Data Collection

Site 3's electricity is procured from PG&E. The procurement costs for Site 3's electricity usage are displayed in Appendix M Figures 30, 31, and 32. The procurement costs shown were all obtained from primary archival documents, the actual PG&E billings. Site 3's electricity procurement costs are considered highly reliable.

Site 3's charges from PG&E were separated into four basic elements: (1) schedule E20P charge, (2) power factor adjustment, (3) energy commission tax, and (4) city tax. PG&E billings included usage information for peak demand and total energy demand; however, separate charges for these factors were not identified. Because separate charges were not identified, the charge classified as schedule E20P incorporates all of the various usage charges levied by PG&E. The power factor adjustment charge is levied whenever Site 3's average power factor load in a month is less than 85%. Energy commission tax and city tax are surcharges levied by the respective agencies. Site 3's electricity procurement charges will next be examined from a total cost perspective for comparison with NAS.

2. Total Site 3 Electricity Charges and Usage

Table 39 shows Site 3's total electricity procurement and usage data for FY 89, 90, and 91. Site 3's electricity usage was very stable during the three year period decreasing only 3% in FY 90 and then increasing by 2% in FY 91. Electricity charges however, increased 10% from FY 89 to 90 and 5% from FY 90 to 91. Annual electricity procurement costs averaged $81.14/MWH over the three year period for an average yearly increase of 8% in unit costs. Only total electricity procurement costs could be evaluated for Site 3 because no further delineation in charges was available on Site 3's billings from PG&E. In the next section total electricity procurement unit costs for all the sites will be compared.

TABLE 39

TOTAL SITE 3 ELECTRICITY PROCUREMENT

	FY 89	FY 90	FY 91
Total Electricity Procurement Cost	$388,304	$426,958	$449,129
Total Electricity Usage (MWH)	5,282	5,099	5,212
Electricity Procurement Unit Cost	$73.51	$83.74	$86.18

N. TOTAL ELECTRICITY PROCUREMENT UNIT COSTS COMPARED

Table 40 shows all four entities' electricity procurement unit costs compared for FY 89, 90, and 91. During all three fiscal years, Site 3's total electricity procurement costs were the highest. Site 3's unit costs averaged 13% more than NAS's procurement unit costs over the three year period. This is perceived to be primarily a result of Site 3's inability to negotiate with the utility company due to its relative consumption.

Site 2's electricity procurement unit costs were the lowest during the period analyzed. On average, for the two years data was available, their unit costs were 27% lower than NAS's unit costs. The extent of Site 2's electricity procurement

cost advantage due to the use of a partnership-like arrangement with a cogeneration supplier of electricity or from other factors involved in contractual rate negotiation could not be determined. Additionally, the supplier's profits are largely a result of sales to PG&E, so PG&E may in effect be subsidizing Site 2.

On average over the three year period, Site 1's electricity procurement unit costs were 11% less than NAS's unit costs. The gap between unit costs closed from a 16% advantage in FY 89 to a 6% advantage by FY 91. Site 1's electricity procurement unit costs increased by 18% over the three year period whereas NAS's unit costs increased only 6% during this period.

TABLE 40

TOTAL ELECTRICITY PROCUREMENT UNIT COSTS COMPARED

FISCAL YEAR	PWCSB	SITE 1	SITE 2	SITE 3
FY 89	$70.34	$59.42	N/A	$73.51
FY 90	$71.24	$63.71	$53.32	$83.74
FY 91	$74.41	$70.03	$53.00	$86.18

O. TOTAL ELECTRICAL DISTRIBUTION UNIT COSTS COMPARED

Table 41 shows electrical distribution system unit costs for FY 89, 90, and 91. These costs are comparable for NAS and Site 1, but Site 2's data is incomplete for comparison. Total electrical distribution costs for PWCSB were nearly five times greater than Site 1's for FY 90 and almost four times greater in FY 91. Although Site 1 had an extensive electrical distribution system capital improvement project in progress at the time and some repair work was deferred, deferred repair work alone cannot account for the large disparity in costs. Chapter VI provides assumptions for comparing site data and in Table 47 provides additional electrical distribution cost breakdown into direct labor and material unit cost components.

TABLE 41

TOTAL ELECTRICAL DISTRIBUTION UNIT COSTS COMPARED

FISCAL YEAR	PWCSB	SITE 1
FY 89	$8.00	N/A
FY 90	$11.26	$2.40
FY 91	$6.68	$1.77

P. TOTAL COMBINED ELECTRICITY PROCUREMENT AND DISTRIBUTION UNIT COSTS COMPARED

Table 42 combines total electricity procurement unit costs from Table 40 with the total electrical distribution unit costs from Table 41 for FY 89, 90, and 91 comparison. PWCSB's combined electricity procurement and distribution unit costs were 20% more than Site 1's for FY 90 and 11% greater in FY 91. Site 2's electrical distribution costs were not comparable because only distribution labor costs are accounted for. Therefore Site 2's costs should not be combined and compared for this category.

TABLE 42

COMBINED ELECTRICITY PROCUREMENT AND DISTRIBUTION UNIT COSTS COMPARED

FISCAL YEAR	PWCSB	SITE 1
FY 89	$78.35	N/A
FY 90	$82.50	$66.11
FY 91	$81.09	$71.80

Q. TOTAL WATER PROCUREMENT UNIT COSTS COMPARED

Table 43 shows the three entities' (NAS, Site 1, and Site 2) water procurement unit costs compared for FY 89, 90, and 91. On average, NAS's water procurement unit costs were the lowest over the period analyzed. NAS's

water procurement unit cost average was $1.25/KGAL, Site 1's was $1.45/KGAL, and Site 2's was $1.77/KGAL. This represents a 16% cost advantage over Site 1's average unit cost and a 42% advantage over Site 2's average unit cost. FY 91 was the only year in which a site, Site 2 had lower water procurement unit costs than NAS. Site 2's unit cost for FY 91 was 14% less than NAS's for this period.

TABLE 43

TOTAL WATER PROCUREMENT UNIT COSTS COMPARED

FISCAL YEAR	PWCSB	SITE 1	SITE 2
FY 89	$1.32	N/A	N/A
FY 90	$1.08	$1.27	$2.39
FY 91	$1.34	$1.62	$1.15

R. TOTAL WATER DISTRIBUTION UNIT COSTS COMPARED

Table 44 shows the water distribution system unit costs compared for FY 89, 90, and 91 between NAS and Site 1.

TABLE 44

TOTAL WATER DISTRIBUTION UNIT COSTS COMPARED

FISCAL YEAR	PWCSB	SITE 1
FY 89	$2.41	N/A
FY 90	$0.64	$0.56
FY 91	$1.27	$0.36

Site 2 data was insufficient for comparison. PWCSB's water distribution unit costs for FY 90 were 13% greater than Site 1 and 72% greater in FY 91. PWCSB's large fluctuations in water distribution costs were primarily from the water capital improvement expenses incurred in FY 89 and 91. In FY 90 PWCSB expenditures for replacement of the water distribution system decreased

significantly incurring only $35,137 in costs as shown in Appendix J Figure 15. If FY 91 water system replacement costs of $511,605 were discounted the unit cost for FY 91 would have been only $0.48. This is still 25% greater than Site 1's water distribution unit cost for FY 91.

S. TOTAL COMBINED WATER PROCUREMENT AND DISTRIBUTION UNIT COSTS COMPARED

Table 45 combines total water procurement unit costs from Table 43 with the total water distribution unit costs from Table 44 for FY 89, 90, and 91 comparison between entities. When procurement costs and distribution costs are combined, Site 1's unit cost for FY 90 is 6% greater than PWCSB's. In FY 91 PWCSB's unit cost is 23% greater. However, if PWCSB's water system replacement costs are discounted again for FY 91 then their combined unit cost is $1.82 or 9% less.

TABLE 45

COMBINED WATER PROCUREMENT AND DISTRIBUTION UNIT COSTS COMPARED

FISCAL YEAR	PWCSB	SITE 1
FY 89	$3.73	N/A
FY 90	$1.73	$1.83
FY 91	$2.60	$1.99

The costs in the six tables above represent a summary of the costs derived earlier in this chapter and in Chapter IV. These costs are not very comparable in the format presented without consideration to the assumptions and data peculiar to each site. A unit cost comparison showing additional components of cost that could be collected is presented. This framework for comparison is provided in the next chapter. The assumptions in data comparison, the factors of

consideration, and a unit cost comparison is provided. Each research question is answered to the extent this research permits.

VI. UNIT COST COMPARISON

This chapter presents additional results from the research. While preceding chapters have provided the background to the research design, historical perspective of the Navy facility management community, site data results, and other pertinent background; this chapter makes the additional comparisons that were the objective of the research. Numerous data shortcomings exist in the research and many factors exist that prevent an easy comparison of the data. However, PWCSB's desire for a comparison of costs between NAS Alameda and Site 1 for the purchase and distribution of electricity were largely achieved.

The shortcomings and factors that limit the comparability of data are discussed first in this chapter. Paragraph A reviews data limitations and its implication on the research. Paragraph B reviews factors that must be considered when comparing site data. While some data assumptions have already been provided in the preceding chapters, Paragraph C presents three new assumptions applicable for the comparisons made in this and preceding chapters. The framework for the comparison is a unit cost presentation in Paragraph D that breaks data into all the cost components that the data permits. Paragraph E addresses the research questions from Chapter I. Recommendations are also made in this section and provided in bullet format. Recommendations are brief and few because the focus of the research was not to provide recommendations from investigations of work processes and procedures but to provide an indication of the cost competitiveness of providing electricity and water service with Site 1 and other local non-DoD sites.

A. DATA LIMITATIONS

Each site's accounting system failed in at least one way to provide the data that were necessary for the research. Several observations relating to sites' accounting systems were noted during field work. For instance, accounting systems could not fully meet the needs of utility managers. Some managers felt accounting data were provided irrespective of manager's needs, claiming data processing to be self-generating. Second, each accounting system was uniquely adapted for the site it served. Some sites had detailed data for direct costs while other sites had detailed data for indirect costs. Some sites had simple accounting systems while other sites had so complicated a system that management could not effectively use or understand it. However, the objective of this section is not to analyze accounting systems. Instead, these brief observations provide insight into the challenges of field work. The shortcomings of data collection that prevented obtaining cost data are reviewed below.

Among the three non-DoD sites, there were seven major data shortcomings related to their inability to provide: (1) direct costs (labor and material), (2) overhead and indirect costs, (3) archival data, (4) data for the three year period of study, (5) capital improvement costs on their distribution systems, (6) contract costs, and (7) costs of operating cogeneration plants. An eighth shortcoming was not only a factor of the non-DoD sites but also for PWCSB; namely, the inability to provide overtime data. Lastly, a number of differing factors at each site hindered data comparisons and analysis.

In reviewing these limitations, the first one prevents comparison of direct labor and material costs for all sites. The second limitation of cost data was the inability to obtain overhead and indirect cost data. Limited data was provided by

some sites and is provided when addressing subsidiary questions in Paragraph E. The third limitation introduces varying degrees of data reliability. When primary archival data was not available for use, secondary sources were used. Often, assumptions were made to gather the costs desired. The introduction of secondary data and assumptions degraded data reliability.

The fourth limitation prevents a comprehensive comparison over a three year period, the minimal period believed to be essential for data validation. Most sites had difficulties retrieving archival information. The unit cost comparison presented later in this chapter eliminates the effect of the data limitation by using any available data during FY 89, 90, and 91 to establish unit costs. Although data might be provided for fiscal years other than FY 89, 90, and 91 in the appendixes, the unit cost comparison in Paragraph D uses data only for the three year period of study. The fifth limitation prevents providing capital improvement unit cost data for Sites 2 and 3. The sixth limitation prevents any comparison on contract costs. Only NAS's contract data could be obtained. The result is that only in-house work costs could be compared.

The seventh limitation of cost data was an inability to obtain cost data on cogeneration plants. Legal and ownership complexities prevented access to cogenerator producers at site locations. The result is that the benefits of cogeneration to the Navy could not be adequately reviewed as intended. The eighth limitation prevents a comprehensive comparison to the use of overtime and how that might contribute to direct labor costs. Some limited data did exist at PWCSB and are used later in this chapter. The final limitation was the differences in comparability factors that require consideration when viewing the

resultant data. The vast array of data limitations and comparability factors make data analysis difficult. This is addressed further in Paragraph B and D below.

B. COMPARABILITY FACTORS

A number of factors require consideration to make a fair comparison of the procurement and distribution unit costs for electricity and water. This chapter presents the unit costs for all sites in Paragraph D; however, to make comparisons without first considering certain factors could lead to erroneous conclusions. No mathematical relationships are used to take into account these site differences, but they are displayed for reference below in Table 46. Listed immediately below in no specific order are the factors that could be compared:

- Building space: All other factors being equal, the greater the square footage of space, the greater the expected procurement cost. Total square footage is an indicator of the relative sites' sizes.

- Length of distribution line: All other factors being equal, the greater the length of line, the greater the expected procurement and distribution cost. Longer lines create line losses which result in procurement expenditures for unused utilities. Longer lines also result in greater distribution costs because of greater requirements for maintenance (preventative maintenance and repair).

- Age of distribution systems: All other factors being equal, the older the utility distribution system, the greater the expected distribution costs. Older systems are expected to result in more frequent repair.

- Wage earner rates: All other factors being equal, wage earner rates impacts distribution costs.

- Building age: All factors being equal, older buildings are expected to be less efficient than newer buildings.

- Work activities on the distribution system: The types of work performed on the distribution system will impact comparability. A survey was used to record representable work on the distribution system. The survey listed

work performed on the NAS distribution system by account title description. Each site was asked to check a work item description if the work is representable of the work the site performed on their distribution system. See the Appendix I for the survey results.

- Consumption pattern: All other factors being equal, the pattern of consumption is impacted by work shifts and hours of operation. Because all sites generally have the same operating hours and consumption pattern, with the exception of Site 3 (seasonal variation in work shifts), this data are excluded from the table below.

- Weather (degree days): Because all sites are in the greater San Francisco Bay area, the assumption made is that all sites experienced the same weather.

TABLE 46

FACTORS OF CONSIDERATION

Factor	NAS	Site 1	Site 2	Site 3
Bldg. Sq. Ft.	5,691,285	5,731,905	11,809,832	65,940
No. Bldgs.	287	157	673	57
Av. Sq. Ft/Bldg	19,830	36,509	17,548	1,157
Elec. Line Feet	~ 322,507	~ 398,000	UNK	11,400
Proc. $/Foot	33.27	22.24	UNK	36.97
Dist. $/Foot	2.66	0.72	UNK	UNK
Wage Rates	~ 17.98	~ 17.57	~ 18.27	~ 8.07
Elec. Sys. Age	10 - 47 yrs	1 - 7 yrs	30 - 115 yrs	7 yrs
Water Sys. Age	1 - 49 yrs	1 - 100 yrs	30 - 115 yrs	7 yrs
Av. Bldg. Age	~ 45 yrs	~ 40 yrs	~ 40 yrs	7 yrs

Notes:

1. Dist $/foot is the distribution costs for preventative maintenance and repair direct labor and direct material costs only
2. Wage rates are in dollars per hour. NAS wage rate is FY 91 average between water and electricity as determined from appendix data. Site 1 rate is the same for electricians and plumbers. Site 2 data is for electricity only and is an average of a range of rates. Site 3 data is an average among all trades.

3. Average building age is estimate by researchers for Sites 2 and 3

Other factors are also pertinent but cannot be compared because of insufficient data, either because the data could not be obtained or because the data was not requested. These factors are areas that could be further investigated.

- Structure uses
- Building heating and air conditioning
- Type of building construction
- Number of personnel working at sites
- Energy conservation efforts

All factors must be considered when comparing data. The data suggests the age of the distribution systems is a large determinant when comparing distribution costs. A high unit cost in maintaining a distribution system need not necessarily mean inefficiencies exist. The last area of review before presenting the unit cost results is the assumptions that impact data comparability.

C. ASSUMPTIONS

Specific data assumptions made for each site are provided in Chapter IV and V. Reference those chapters if data assumptions require further review. Two additional assumptions are made in this paragraph to permit comparison of the data in Paragraph D. An additional caution is made in the third assumption that relates to trend data displayed throughout the thesis.

1. Fiscal Years

Each of the four sites researched collect data by fiscal year. All sites had fiscal years with differing start dates. Three of the four had fiscal year start

dates in the last half of the calendar year while only one fiscal year coincided with the calendar year. The unit cost comparison presents data in fiscal years maintained by each site. No attempt is made to cross data into different months for a standardized fiscal year. Inflation therefore can impact the data comparability when comparing costs between sites. The extent of the impact is discussed below.

2. Nominal Dollars

All costs are presented in nominal dollars. The costs are those actually incurred for the year displayed. The effect of comparing costs between sites with different fiscal years is not significant, however. Inflation in the utility sector over the years of study is very low and the greatest difference in fiscal year start dates is five months with three of the sites within three months. The result is negligible for comparison purposes.

3. Trend Computations

The thesis provides trend data from data that were available. Average annual changes for instance typically are based on the change between FY 89 and 91. Consequently, the data for each of these years greatly impacts the trend data. Trend data presentations should not necessarily be assumed to be representative of a longer term trend.

Paragraphs A, B, and C have presented the data limitations, comparability factors, and assumptions. The electrical and water procurement and distribution unit costs at all sites are presented in the next section. Tables 47 and 48 in Paragraph D are the most comprehensive display of the results of the research.

D. COMPARISON ANALYSIS

The comparison of electricity and water utility costs between PWCSB and the local sector were designed to be segregated in a number of ways. The costs of PWCSB were designed to be limited to that of NAS Alameda while the local sector was limited to three non-DoD sites. Costs were segregated into two types, procurement and distribution. When data permitted, procurement costs were segregated in Chapters IV and V into cost components as shown on utility bills. Distribution costs were also segregated into preventative maintenance, repairs, and capital improvements when data permitted. Distribution costs were further segregated into the cost components of direct labor, direct materials, and contracts. Some designed cost segregations were not possible because of data limitations as were discussed in the first section of this chapter. In this section, costs will not be segregated any further but will be displayed comprehensively on a unit cost basis .

What does this mean? Direct comparison between sites can be made on all segregated cost groups on a unit cost basis. This approach is different from a comparison in the aggregate. An aggregate approach might display the unit cost for distribution, for example. The approach used here is to display not only the aggregate cost for distribution, but the cost for direct labor, direct material, and contracts for each of distribution's cost components; namely, preventative maintenance, repairs, and capital improvements. Presentation of unit cost by all cost components allows for easy recognition of absent data that skews comparison in the aggregate. Table 47 and 48 below also permit easier identification of cost areas needing managerial focus. These tables represent the most comprehensive data display of the research.

All unit costs are direct costs as previously presented in Chapters IV and V. The unit cost data in Table 47 and 48 are derived from the cost data for the three fiscal years of the study that each site could provide. These unit costs therefore represent an average unit cost during the three year period or any lesser period if data availability was limited. For example, the unit cost data in Tables 47 and 48 were derived for Site 1 using cost data from FY 90 and 91 whereas the unit cost data for NAS were derived from FY 89, 90, and 91 cost data. Procurement costs are shown in the aggregate. Direct labor distribution cost is for labor's base rate only. Fringes, benefits, and acceleration costs are not included. Where data were not available, N/A is inserted in Table 47 and 48. Site 2 and 3 provided aggregate data for direct labor costs. In these cases, UNK is used to represent unknown sub components of aggregates data.

Cost differences can be explained in part by comparability factors identified above in Paragraph B. Site managers are expected to network to further investigate why some sites might be operating at lower costs and to qualify their direct labor and direct material costs against the other research sites. Although the focus of the research was not to explain cost differences, some suggestions as to the results are offered below should future site cooperation in networking fail.

TABLE 47

ELECTRICITY UNIT COSTS

Distribution	Direct Labor	Direct Material	Contract	Total
Preventative Maint.				
NAS	1.00	0.55	0.09	1.64
SITE 1	0.03	0.01	~ 0	0.04
SITE 2	UNK	N/A	N/A	N/A
SITE 3	UNK	N/A	N/A	N/A
Repairs				
NAS	2.05	2.15	0.14	4.34
SITE 1	1.67	0.39	~ 0	2.06
SITE 2	UNK	N/A	N/A	N/A
SITE 3	UNK	N/A	N/A	N/A
Capital Improvement				
NAS	0.19	0.78	1.68	2.65
SITE 1	0	0	~ 0	0
SITE 2	UNK	N/A	N/A	N/A
SITE 3	UNK	N/A	N/A	N/A
Total Distribution				
NAS	3.24	3.48	1.91	* 8.63
SITE 1	1.70	0.39	~ 0	2.09
SITE 2	1.34	N/A	N/A	N/A
SITE 3	0.50	N/A	N/A	N/A
Procurement				
NAS	N/A	N/A	N/A	71.88
SITE 1	N/A	N/A	N/A	64.35
SITE 2	N/A	N/A	N/A	53.16
SITE 3	N/A	N/A	N/A	81.09
COMBINED TOTALS				
NAS	N/A	N/A	N/A	80.51
SITE 1	N/A	N/A	N/A	66.44
SITE 2	N/A	N/A	N/A	N/A
SITE 3	N/A	N/A	N/A	N/A

* Note: NAS total distribution unit cost is different from Table 10 reported at $8.66 because of the cumulative net rounding errors from the subcomponents in Table 47

TABLE 48

WATER UNIT COSTS

Distribution	Direct Labor	Direct Material	Contract	Total
Preventative Maint.				
NAS	.04	~ 0	~ 0	0.04
SITE 1	~ 0	~ 0	~ 0	~ 0
SITE 2	UNK	N/A	N/A	N/A
Repairs				
NAS	0.32	0.17	0.03	0.52
SITE 1	0.31	0.15	~ 0	~ 0.46
SITE 2	UNK	N/A	N/A	N/A
Capital Improvement				
NAS	.09	0.23	0.57	0.89
SITE 1	~ 0	~ 0	~ 0	~ 0
SITE 2	UNK	N/A	N/A	N/A
Total Distribution				
NAS	0.45	0.40	0.60	1.45
SITE 1	0.31	0.15	~ 0	~ 0.46
SITE 2	0.12	N/A	N/A	N/A
Procurement				
NAS	N/A	N/A	N/A	1.25
SITE 1	N/A	N/A	N/A	1.44
SITE 2	N/A	N/A	N/A	1.82
COMBINED TOTALS				
NAS	N/A	N/A	N/A	2.70
SITE 1	N/A	N/A	N/A	1.90
SITE 2	N/A	N/A	N/A	N/A

1. Procurement Costs

a. Electricity

Electricity procurement costs are largely a factor of the rate structure of utility companies, approved by public utility commissions. Any perceived unfairness in pricing is an issue for sites to take up directly with their utility supplier and public utility commissions. Compared to the most comparable site, Site 1; Navy procurement costs for NAS averaged 11% higher over the three

year period. Site 2 may or may not be receiving favorable pricing because of a partnership-like arrangement with its supplier. Site 2 provides facilities and utilities to the cogenerator producer which is on Site 2's property. In any regard, the Navy's procurement cost for NAS is about 35% higher than Site 2. Site 3 is a low consumption user of electricity not particularly useful for a procurement cost comparison.

Appendix F and Table 57 provide evidence that, while Alameda's Bureau of Electricity rates may appear competitive with PG&E within PWCSB accounts, it appears that it is less competitive in comparison to Sites 1 and 2. Appendix F also provides evidence that PG&E billings to Navy accounts are higher than PG&E billings to Site 1 by 13%. One of those Navy PG&E accounts is NSC Oakland. While the research did not focus on NSC Oakland, the following illustration is useful to alert management that Navy accounts may be billed disproportionately high. NSC Oakland and Site 1 are both supplied electricity by PG&E. On a unit cost basis, NSC Oakland was billed more than 7% over that of Site 1 on average over the three year period of study. The emerging pattern is that Navy billings from the Bureau and PG&E are higher on a unit cost basis than Sites 1 and 2.

Site 1 once was able to negotiate lower procurement costs by comparing its costs to that of another entity in the same PG&E rate class, Bay Area Rapid Transit (BART). The comparison cannot be made for Site 1 and NAS because the electricity is supplied to each site by different suppliers. However, PWCSB is justified in seeking lower procurement costs from the Bureau. Procurement savings represents a large pool of costs where potential savings can be achieved.

The results of this research alone is not indicative of unfair pricing, although it is suggestive. The research certainly shows that electrical unit procurement costs for NAS are higher than Site 1 or Site 2 by 10 - 35%. Although Navy policy requires utility procurement from commercial sources, no evidence was found to suggest that the Navy should subsidize other electricity payers by paying more than the non-DoD sector. Other than seeking a more favorable rate structure, several other recommendations to reduce procurement costs are made for consideration:

- Continue conservation efforts of peak and energy demands. The Bureau's cost burden shifts from fuel cost adjustments to energy charges providing the incentive to reduce overall energy usage.

- Target other customers for energy demand conservation. NAS is the only PWCSB customer who has shown the ability to reduce energy demand in the three year period. See Appendix B.

- Invest in demand meters for high consumption tenants identified in Appendix D. (Recommendation is made without regard to the cost of demand meters. A cost/benefit analysis could not be made.) The method of allocating procurement cost to Navy customers does not provide an incentive for customers to coordinate or manage peak demand. Allocation based on peak demand consumption could result in greater peak demand conservation and load shedding efforts from customers.

- Install meters for customers who are unmetered to provide an incentive to reduce energy usage. Unmetered customers might waste energy because of the feeling that their savings from lowered consumption will be allocated to other users. Sell the idea of metering to unmetered customers to seek customer funding. Interface with unmetered customers showing trend analysis for their activity. Capital investment in meters might result in more immediate benefits than a phased meter installation plan.

- Make someone responsible for regular trend analysis so managers are aware of consumption patterns and customers are aware of their

consumption. Make consumption reports to customers so they are aware of costs.

- Continue to pursue WAPA power as it continues to be a cheap source of electricity and will be more competitively sought.

- Price pre-determined rates per individual customer. Customers might waste energy because of the feeling that their savings from lowered consumption will be allocated to all other users.

- Seek innovative thinking on alternate generation sources. Further areas of research are identified in the following chapter.

Electrical procurement savings are essential for achieving substantial cost savings. Because procurement costs represent such a large portion of the total unit cost, it deserves top priority in cost reduction efforts. Water procurement is compared below.

b. Water

Water procurement costs are largely a factor of the rate structure of utility companies approved by public utility commissions. Any perceived unfairness in pricing is an issue for sites to take up directly with their utility supplier and public utility commissions. Navy procurement costs for NAS averaged 13% lower over the three year period compared to Site 1 and 31% lower compared to Site 2. Site 3 is a low consumption user of water not particularly useful for a procurement cost comparison.

Common data for the three sites existed for FY 90 and 91. NAS and Site 1 is served by East Bay MUD while Site 2 is served by a city source. Site 2 is the high user of water averaging procurement at 964,207 KGALs of water per year. Site 2 also has the highest average unit procurement cost at $1.82, potentially representing the high unit cost of high usage. Computer and laser cooling at Site 2 was identified as reasons for high water usage. NAS and Site 1

usage averaged 635,720 KGALs and 511,083 KGALs of water per year respectively. Site 1 data represents only one account representing about 75% of water usage. Adjusting Site 1 data to 100% puts average usage within 2% of NAS's usage. Because both NAS and Site 1 are supplied by East Bay MUD and have similar consumptions, NAS and Site 1 costs are very comparable.

NAS's water procurement unit costs are lower than Site 1 by $0.19/KGAL. Both sites negotiated with East Bay MUD concerning penalty charges that were levied because of stair stepped rates based on metered consumption. The Navy negotiated that their four accounts be charged stair stepped rates based on water consumption of all accounts, not any one account. The Navy realized no penalty charges after negotiations. Site 1 negotiated that their seventy or more accounts be charged stair stepped rates based on water consumption of like accounts based on facility function. Site 1 paid some penalty charges. Whereas NAS water billings were obtained from East Bay MUD bills, Site 1 and 2 procurement costs were obtained from internally prepared spreadsheets. Site 1 and 2 recorded penalty charges in their spreadsheets that may have later been credited or negotiated. NAS's unit procurement costs reflect negotiated costs after credits for penalties. Penalty charges account for $0.09 of Site 1's water procurement unit cost. Even with a $0.09 deduction to Site 1's unit procurement cost of $1.44, NAS appears to have favorable water procurement costs.

Despite the good news, one trend is worthy of management's attention. NAS usage increased 7% between FY 90 and 91 while the other sites experienced usage decreases of about 10 to 15%. The trend merits further investigation into water usage at NAS. Water usage at NAS experienced a

decrease between FY 89 and 90 but increased between FY 90 and 91. The increase in usage at NAS when the non-DoD sector show decreases should be disturbing if increased demand cannot be adequately explained. Recommendations for lowering water procurement costs include:

- Make someone responsible for regular trend analysis so managers are aware of consumption patterns and customers are aware of their consumption.

- Price pre-determined rates per individual customer. Customers might waste water because of the feeling that their savings from lowered consumption will be allocated to all other users.

Electrical and water procurement costs comparisons have been reviewed. NAS unit procurement costs for electricity are not competitive with Site 1 or Site 2. NAS unit procurement costs for water are not only competitive but favorable to the other sites. Procurement costs though are only one component of the total costs; the other is distribution costs. Because distribution costs at NAS represent only about 10% of total electricity costs, they deserve secondary priority. They deserve greater priority on the water distribution system. Because of the water upgrade project at NAS, distribution costs represent 54% of the total water costs during the three year period. Without the water distribution upgrade project, distribution costs would have represented 36% of the total water costs. Distribution costs for the electrical and water distribution systems are reviewed next.

2. Distribution Costs

a. Electrical

Whereas procurement cost data is highly reliable, distribution cost data is less reliable and less abundant. The data limitations of Paragraph A

explained data shortcomings. Distribution cost data in Table 47 for NAS and Site 3 is based on data for FY 89, 90, and 91. Site 1 data is based upon FY 90 and 91 data. Site 2 data is based upon FY 91 data only. The data site assumptions used in Chapters IV and V are still applicable. For example, Site 1's multimillion dollar electrical system upgrade was not included in the capital improvement data. Also some site's data are considered more reliable than others. The reliability of distribution cost data for NAS and Site 1 is high. Because of major assumptions made to derive costs at Site 2 and 3, data are acceptable for broad comparison only.

Some general observations are noted from Table 47. Direct labor costs for maintenance (the sum of preventative maintenance and repairs) are the only cost components in which all four site's data can be compared. NAS is high with a cost of $3.05/MWH. Similar costs for Sites 1, 2, and 3 are respectively $1.70, $1.34, and $0.50 per MWH. Because Site 2 and 3 could not provide data in other cost components, the remaining comparisons can only be made with Site 1. In comparison to Site 1, NAS costs are high in every cost component that can be compared. Why NAS unit costs are higher is reviewed below by presenting variables that contribute to direct labor costs, direct materials, and contract costs.

1. Direct Labor Costs. NAS maintenance direct labor costs are about 200% higher than the average of the same costs at Site 1 and 2. NAS is not competitive in this regard to these two sites. Site 2's data reliability is skeptical and is used with caution. Unit direct labor cost differences on the distribution systems might be explained by wage earner rates, the mix of straight time - overtime labor hours, the type of tasks performed, the age and condition of

the distribution system, preventative maintenance procedures, and inefficiencies. Each of these variables are addressed individually below:

Wage earner rates: NAS FY 91 average wage rate from appendix data is $18.84. Site 1's wage rate effective January 1992 is $17.57. Site 2's wage rate between 1 September 1991 and 27 February 1992 ranges from $16.52 to $20.01. Site 3's average trade wage rate was $8.07. These are base rates only. Because trade laborers do not belong to a union and worker trade qualifications are less than those at other sites, Site 3 has wage earner rates about half of that at the other sites. If acceleration, fringes, and benefits are compared, Site 1 paid 25% in benefits in the last fiscal year. Site 2 similarly paid 31% in benefits. Site 3 paid about 50% in benefits or about $4.43 per hour.

The mix of straight time and overtime: NAS's overtime cost on the electrical system is historically about 10% of the total direct labor costs on the system. Site 1 had no data available. Site 2 historical data was unavailable but their budgeted overtime labor hours to total labor hours for FY 92 is comparable to NAS at 8%. Site 3 maintains overtime at less than 3% of all direct labor hours. All sites stated a bona fide need for overtime. NAS's use of overtime might be marginally more than the other sites, but data were insufficient to make any significant conclusions. Reference Appendix H question 4 for sites' responses to the use of overtime and Appendix G regarding recommendations on where to focus on PWCSB reduction of overtime use.

The age and condition of the distribution system: Regarding electrical systems, Site 1 and 3 have relatively new systems which would be expected to demand lower maintenance costs. NAS and Site 2 have older systems and are better for comparison in this regard. The age of the systems is

believed to be a significant factor as to why Site 1 and Site 3 have lower direct labor costs than NAS; but if Site 2's data is even reliable within ±50%, the data would suggest the age difference in systems can only partially explain NAS's high unit cost. The data suggests PWCSB's labor costs are high even when considering a new system. System age impact cannot be determined from this research, which makes comparability of the data for the electrical distribution system difficult.

The type of tasks performed: The number of hours spent on the distribution systems because of the tasks being performed is directly related to labor costs. For the electrical distribution systems, NAS direct labor hours averaged 0.1834/MWH over the three year period. Site 2 direct labor hours averaged about 0.0665/MWH. Site 2 was assumed to average 10,034 direct hours annually. The assumption is based on data in Appendix H, question three. Site 3 direct labor hours averaged .0620 per MWH over the three year period. Site 1 data is unavailable but is assumed to be also less demanding on labor than NAS because of the construction of their new electrical distribution system. If a wage rate of $17.57 (current rate) is assumed over FY 90 and 91, then Site 1 averaged about 13,134 direct labor hours on the distribution system. Under this assumption, Site 1's direct labor effort is 0.0955/MWH. Reviewing the results of direct labor hours per MWH, NAS is 0.1834, Site 1 is 0.0955, Site 2 is 0.0665, and Site 3 is 0.0620.

Direct labor hours compared to length of line is also calculated in comparison to Site 1 and 3, the only other sites for which data permits comparison. NAS averaged 0.0849 direct labor hours per foot of line while Site 3

averaged 0.0282 direct labor hours per foot of line. Under the same assumptions as before for Site 1, Site 1 averaged 0.0335 direct labor hours per foot of line.

The lower maintenance effect of Site 1 and 3 due to newer systems must continue to be kept in mind. Also, Site 3 has far less operating hours than the other sites during the year. NAS may have greater requirements. For example, PWCSB probably maintains more mobile utility support equipment (MUSE). Surveys were used to measure requirements. These are provided in the Appendix I and indicate NAS does perform a greater variety of functions. However, the implication comparing all sites is that management should focus on reducing direct labor hours on the NAS electrical system. About two thirds of the total direct labor hours on the electrical distribution system at NAS is attributable to two accounts, Minors and DEIS. Cost reduction efforts should start with reviewing the cost drivers of these accounts. The direct labor hour data used for the calculations above were that in Appendix H, question 2.

Preventative maintenance philosophy: The reason for executing preventative maintenance is long term savings by prolonging equipment life and reducing repair costs. Preventative maintenance is believed to reduce repair costs in the future by maintaining equipment in efficient operating order. Conclusive arguments from the data cannot be made because the extent of Site 1's lower unit costs related to the new electrical distribution system is unknown. However, a huge differential in preventative maintenance costs exists between NAS and Site 1. Not much more can be noted here; however, this observation is referenced later when analyzing similar unit costs for the water procurement data.

<u>Inefficiencies</u>: Inefficiencies may or may not be contributing to the high unit labor cost. Does higher distribution labor costs result in a better material condition of NAS's distribution system? Distribution system material conditions were not inspected to make a determination.

2. Direct Material. NAS material unit costs are 892% higher in relation to Site 1. A more appropriate indicator of cost is the ratio of direct material costs to direct labor costs. Direct materials to direct labor rates for NAS and Site 1 in preventative maintenance is respectively 0.55 and 0.33. Similarly, the ratios for repairs are 1.05 and 0.23 respectively. Site 1's ratio is constant between preventative maintenance and repairs while NAS repair material costs are indicative of their procuring policy in that 80% of repair material is purchased quickly by telephone bid. Total direct material cost per MWH for preventative maintenance and repairs for NAS over the three year period is $2.70 but only $0.40 for Site 1.

Variations in direct material costs might be explained by procurement methods, material costs, tasks being performed, age and condition of the system, preventative maintenance philosophy, and inefficiencies. Many of these costs are duplicative of those already mentioned above and are not discussed further. Because many of the variables that can create variations in direct material costs are already explained and because of the limited data availability, none of these variables are further addressed. Answers the research obtained regarding procurement methods are provided in Appendix H, question 25.

NAS's greater labor effort on their electrical distribution system is also expected to result in greater material costs. What was not expected were

the ratio differences of direct materials to direct labors between NAS and Site 1. The ratio of direct materials to direct labor dollars, for preventative maintenance and repairs only, for NAS and Site 1 is 0.8852 and 0.2352 respectively. NAS direct material costs appear high if the impact of Site 1's new system is not considered. The research cannot make any conclusive explanations on NAS's direct material costs but they warrant further review. The extent that the difference is related to inefficiencies is indeterminable with the data that exists. However, a recommendation is to establish long term relationships with suppliers by terminating traditional low price bidding.

3. Contracts. Contract data is only available for NAS.

In summary, NAS is estimated to outspend all other sites on preventative maintenance. Is preventative maintenance paying for itself? Is it being performed efficiently? Repair labor costs also deserve focus because it is the largest component of cost. Direct material costs for repairs are high when compared to preventative maintenance. The purchasing policies of an emergency part for a repair indicate higher costs than for planned parts necessary for preventative maintenance. Prudent material purchasing suggests maximization of planned parts. Purchasing in the short run is costly. The data suggests time is indeed money.

All comparisons to Site 1 have been made without including its costs of replacement upgrade exceeding $14 million. The procurement and distribution cost split for NAS was about 90-10 percent compared to Site 1 which was at 97-3 percent. If Site 1's distribution system replacement project is included as a cost on a prorata basis (meaning costs are distributed evenly over the months of construction), then its distribution unit costs increased by

$17.59/MWH making NAS appear nearly three times less costly. With the $17.59/MWH factor included, Site 1's procurement and distribution cost split would be about 79-21 percent.

b. Water

Whereas procurement cost data is highly reliable, distribution cost data is less reliable and less abundant. The data limitations of Paragraph A explained the causes of data shortcomings. Distribution cost data at NAS are based on data for FY 89, 90, and 91. Site 1 data are based upon FY 90 and 91 data. Site 2 data are based upon FY 91 data only. Because of the assumptions made to derive certain costs, the reliability of distribution cost data for NAS and Site 1 is high. Reliability of Site 2 data are acceptable for broad comparison only.

Some general observations are noted from Table 48. Direct labor costs for the sum of preventative maintenance and repairs are the only cost components in which data can be compared for three sites; NAS, Site 1, and Site 2. NAS is high with a unit cost of $0.36/KGAL. The unit costs for Sites 1 and 2 are respectively $0.31/KGAL and $0.12/KGAL. In comparison to Site 1, NAS labor costs appear competitive in repairs but high in preventative maintenance. Job Order Number 5154514 Service Water Distribution System is driving this cost. Variables that contribute to direct labor costs, direct materials, and contract costs are reviewed below.

1. Direct Labor Costs. Unit direct labor cost differences on the distribution systems might be explained by wage earner rates, the mix of straight time - overtime labor hours, the type of tasks performed, the age and condition of the distribution system, preventative maintenance procedures, and inefficiencies. Each of these variables is addressed individually below:

Wage earner rates: FY 91 NAS average wage earner rates from appendix data indicates a prevailing rate of $17.11/hour. Site 1's rate after January of 1992 was $17.57. Site 2's prevailing rate was about $18.27 ranging from $16.52 and $20.01 between 1 September 1991 and 27 February 1992. NAS's labor costs are favorable compared to the other sites.

The mix of straight time and overtime: This data was unavailable at all non-DoD sites.

The age and condition of the distribution system: Regarding water distribution systems, NAS has the newer distribution system but fails to yield cheaper unit maintenance costs. The NAS water project upgrade represented 52% of all distribution costs on the water distribution system over the three year period. NAS will reflect higher distribution costs because of the water replacement project.

Preventative maintenance philosophy: As with electricity, water preventative maintenance is higher than Site 1. NAS paid $0.04/KGAL for preventative maintenance on the water system over the three year period whereas Site 1 paid $0.00/KGAL over the two year period of FY 90 and 91. Despite having an older water system, Site 1 also paid less in repairs than NAS indicating higher preventative maintenance effort by PWCSB may not be yielding proportionate decreases in repair costs. Site 1 paid $0.46/KGAL for repairs while NAS paid $0.49/KGAL. PWCSB appears competitive in repairs but the NAS water system is newer and receives more preventative maintenance effort. In comparison with Site 2, both NAS and Site 1 are about three times more costly. Site two data are viewed less reliable than the NAS and Site 1 data and are not referenced further in the comparison.

2. Direct Material. NAS material costs appear competitive in relation to Site 1. Recommendations include maximizing planned purchasing and reviewing processes and procedures for inefficiencies in the Minors and Job Order Number 5154514 account. Long term relationships with suppliers should be pursued to minimize material costs. The new system at NAS was expected to yield large maintenance savings as Site 1 realized in the electrical distribution systems. A savings in maintenance cost did not appear to exist.

Distribution of material cost data indicates NAS is competitive with Site 1. The finding should not cause relaxation because the new system at NAS was expected to yield large maintenance savings as Site 1 realized in the electrical distribution systems. A savings in maintenance cost did not appear to exist.

In summary, PWCSB appears to expend more funds for preventative maintenance and repairs. The question of preventative maintenance efficiency is again raised. The procurement and distribution cost split for NAS over the three year period is about 45-55 percent. If the costs of the water replacement upgrade and contract distribution cost are removed for comparability purposes, the split for NAS procurement and distribution costs is 60-40 percent respectively. Site 1's procurement and distribution cost split is 75-25 percent respectively. As with the electrical distribution system, NAS spends more on the water distribution system on a unit cost basis than Site 1 spends. NAS conclusively outspends Site 1 on in-house water distribution costs by 18% when factors such as age of the distribution system and wage earner rates indicate NAS should spend less in comparison.

3. Contracts. Contract data is only available for NAS.

E. RESEARCH QUESTIONS AND ANSWERS

The research attempts to answer one primary question: Has PWCSB's costs to procure and distribute electricity and water been "competitive" with the local non-DoD sector? As data collection permitted, six subsidiary questions were to be addressed. Each question is sequentially addressed below.

1. How does the PWCSB's procurement costs of electricity and water compare to procurement costs of the same utilities in the local non-DoD sector on a unit cost basis?

PWCSB electricity procurement costs for NAS Alameda are not competitive with the local non-DoD sector. The Navy paid 10% to 35% more for electricity from the Bureau on a unit cost basis than Sites 1 and 2 representing an additional amount of $7.53/MWH to $18.72/MWH over the three year period of FY 89, 90, and 91. The additional average annual costs may range from $1,073,056 to $3,755,696. The lower end of the range is more likely because the higher estimate is based on Site 2's costs which appear low because of potential partnership arrangements with the electrical supplier. In the aggregate, PG&E billings of PG&E serviced customers are 13% higher than Site 1. This corresponds to increased annual costs of about $940,615 or $6.74/MWH. PWCSB water procurement costs, on the other hand, are not only competitive with the local non-DoD sector, but they are favorable. Cost advantages as compared to Site 1 over the three year period is 13%. The cost advantage as compared to Site 2 is 31%. Negotiating penalty charges and lower consumption levels contributed to its cost advantage.

2. **How do PWCSB's distribution costs of electrical and water distribution systems compare with the same in the local non-DoD sector on a unit cost basis?**

Data limitations restrict the comparison to only in-house work at each site. Contracting costs could not be compared. Electrical distribution costs at NAS were appreciably high because of high labor costs but also high material unit costs. Newer distribution systems and lower preventative maintenance expenditures contributed to lower distribution costs at non-DoD sites. Site 1 deliberately did not perform some maintenance because of the construction of their new system during the period of FY 89, 90, and 91. Comparison between NAS and Site 1 is difficult because the extent to which the new distribution system at Site 1 contributed to lower costs is unknown. Maintenance material costs appear to be an area where cost reduction efforts could be directed. Shifting focus to the water distribution system, NAS spent not only more on preventative maintenance on a newer system, but also spent more on repairs on a unit cost basis in comparison to Site 1. Data was sufficient to conclusively deduce that PWCSB maintenance distribution unit costs (preventative maintenance and repairs) are higher than Site 1 by 285% for the electrical distribution system and 18% for the water distribution system. The reasons why are better left for the review of utility managers.

3. **How does PWCSB's preventative maintenance of the electrical and water distribution systems compare with preventative maintenance of a similar system in the local non-DoD sector?**

The research data suggest NAS may be outspending Site 1 in preventative maintenance with no comparable savings on repair costs. The suggestion is NAS is overspending in preventative maintenance to be competitive. The accounts collecting preventative maintenance costs on the

electrical distribution system are: 5114602 Maintain pier lights, 5114604 PMI emergency generators, and 5114606 DEIS. DEIS represents about 98% of preventative maintenance costs. Any search for savings should start with the DEIS account. The accounts collecting preventative maintenance costs on the water distribution system are 5154514 Service water distribution system, 5154604 PMI water distribution system, and 5154606 DEIS. Account 5154514 represents about 56% of the preventative maintenance effort on the water distribution system.

4. How does PWCSB budget for utility distribution costs and how does it compare to the processes used in the local non-DoD sector? Can a better system for PWCSB's predetermined rate determination be suggested?

The reader should reference Chapter II for a description on how utility distribution costs are budgeted at PWCSB. Chapter II noted three shortcomings with the budget system: (1) the political nature of the rate making process, (2) the lack of decentralization to change the rate structure after rates have been set, and (3) the timing of the rate making process. These are further detailed below. Budget comparisons between sites then will be briefly explained followed by suggestions for improvements.

The rate making process at PWCSB in the past has focused on customer reaction and impact rather than on adjusting rates to capture past losses or distribute past gains. Rates were set to provide pricing stability minimizing rate fluctuations. Revenue increases were made frequently by raising a small number of commodity rates while the majority of the rates were decreased or left the same. Electricity is often targeted as a revenue source. A small increase in the electricity rate generates large revenues because of the

high usage of that commodity. Commanding Officers also have a trend of raising prices upon reporting to PWCSB and decreasing rates when leaving PWCSB. DBOF requires recovery of losses and the distribution of profits in subsequent rates which PWCSB anticipates will result in greater rate fluctuations. While the political forces of appeasing customers by stabilizing rates has been a potential hindrance in the recovery of past losses for PWCSB, the lack of decentralization has been a greater barrier to full recovery of costs.

The second shortcoming to managing variances in the budgeting process is centralization maintained in the rate making process by NAVFAC, NAVCOMPT, OSD, and OMB. Predetermined rates are set for a period of one fiscal year by the OSD/OMB review. Commanding Officers relinquish control of the rate making process in subsequent review by NAVFAC, NAVCOMPT, and OSD/OMB review. Some of the commodity variances in the FY 91 budget were a result of factors in the local area; changing project priorities, weather phenomenon, and local demand. Commanding Officers might better achieve zero profit if allowed the authority to change predetermined rates to account for changes during the year in revenues, expenses, and demands. The third shortcoming relates to timing and PWCSB's customer reliance on stabilized rates to determine their budget needs.

PWCSB constructs budget submissions and predetermined rates during the spring for the budget year, present year plus two. PWCSB's Commanding Officer, NAVCOMPT, OSD, and OMB adjust budgets through December before being incorporated into the President's Budget in January. The proposed rates are modified in the spring, one year after the original proposals. Rates are announced to customers in the summer of the second year. The impact of this

process is that rates are not available to customers at the time of their budget preparation and submittal for the President's Budget. Although the process proposes rates almost two years ahead of time, determination of rates actually occurs a year later than when customers need it.

The political nature of rate making is not expected to change. DBOF may result in better pricing, but PWCSB personnel remain skeptical. Skeptics believe the rate making process is not expected to appreciably change. The centralization of the rate making is also not expected to change. Some PWCSB personnel believe better pricing could be achieved if PWCSB maintained the authority to establish rates. The PWCSB Comptroller believes the budget process is better served by higher authority setting the rates as the current system maintains. OSD, OMB, NAVCOMPT, and NAVFAC are not likely to relinquish control voluntarily. The timing problems are not likely to be resolved any time soon either. TQL techniques must be applied to build consensus and empower the PWCs if any changes are expected to be forthcoming.

Unfortunately, this research found no budgeting techniques appreciably different at other sites. No sites used algorithms. Each site budgeted using historical data from past budgets that factored future project costs and manpower into budget preparations, essentially bottom line budgeting. Site 1 makes some budget preparations based on average square foot data. The use of a rate setting process similar to the Navy's exists at Site 1 and Site 2. NAS, Site 1, and Site 2 establish rates to collect procurement and distribution costs. Data was insufficient to permit an appreciable comparison of rates during the time periods of study. Site 2 rates were altered monthly instead of yearly.

Better budgeting techniques than currently employed at PWCSB must be found if budgeting errors on utility commodities of 200+% wish to be eliminated. Great interest among all PWCs exists to find better budgeting methods. Addressing the budgeting of utility commodities as a subsidiary question of this research does not give the subject proper attention. This area requires further research efforts than could be applied in this study. Some suggestions for better budgeting are provided below:

- Track costs and make more use of unit costing to forecast costs.
- Modify the ADP system to permit extraction of data that managers require.
- Fully Integrate customers into the budgeting process.
- Remove political barriers from the rate making process. Budget utility commodities independently of the rest of the budget. Distribute gains or collect losses yearly on each utility commodity separately.
- Obtain decentralization of the rate making process.
- Network further with the research participants to gain more detail as to budgeting techniques employed.
- Seek networking with utility companies to learn their techniques.

5. **How does the amount of PWCSB's overhead compare with the same in the local non-DoD sector?**

Insufficient site data prevents an adequate comparison. However, limited data was collected from three sites regarding Utilities Department Supervision Costs. PWCSB supervision costs appear higher compared to the local non-DoD sector.

Site 3 was included in the research specifically as a comparison for indirect costs so that a comparison of indirect costs between NAS and a private organization could be made. Although Site 2 is a private organization, it

resembles a public organization. PWCSB was expected to have higher indirect costs than private organizations. The research was designed to prove or disprove the notion. Data limitations presented in Paragraph A of this chapter prevent a conclusive deduction.

PWCSB Utilities Department Supervision Costs for FY 89, 90, and 91 were $1,105,362, $1,249,955, and $1,376,409 respectively. The growth in supervisory costs is averaging 12% a year. Site 3 on the other hand had decreasing costs of $243,300, $256,500, and $218,100 respectively for FY 89, 90, and 91. The only cost data from Site 1 was for FY 91 with supervision costs of $964,695. Site 2 data was unavailable.

To compare these figures, one must take into account the organizational structure, number of personnel being supervised, yearly supervisory salaries, responsibilities of the utilities departments, and a host of other factors. The best comparison this research can provide is to relate these costs to size indicators for the organization and show a gross comparison. Because site electricity consumption and total facilities square footage is presumed to be indicative of the Utilities Departments size and responsibilities, indirect supervision costs are related to these bases. The average Utilities Department Supervision cost per MWH for NAS, Site 1, and Site 3 respectively were $8.33/MWH, $7.13/MWH, and $46.04/MWH. The average Utilities Department Supervision cost per square foot of facilities respectively are $0.22/sq ft, $0.17/sq ft, and $3.63/sq ft. These costs are not the electrical supervision costs but the total Utilities Department supervision costs.

Although these comparisons are gross in nature, two observations are made. Site 3, the private organization, has the highest unit cost for supervision

although their gross costs are the lowest. A certain amount of supervision costs can be considered fixed costs irrespective of facility size. Unit costing assumes all costs are variable. Site 3 supervision unit costs are presumed to be victim to a high distribution of fixed costs and a low distribution of variable costs. The second observation is that PWCSB's supervision costs are about 30% higher than Site 1 for FY 91, the only year data can be compared. Data are insufficient to presume PWCSB is overstaffed compared to the non-DoD local sector, but the minimal data here is suggestive that it could be possible.

6. What are the benefits to PWCSB from generating electricity instead of procuring it?

Evaluating cogeneration alternatives could not be pursued. Benefits from self generation are flexibility of use and perhaps long term economy. Navy policy is to procure utilities from commercial sources where economically feasible. However, numerous challenges confront PWCSB's self generation of electricity to include: funding, air quality issues, lobby groups, and base closures.

Data limitations, comparability factors, and assumptions have been previewed prior to presentation of unit cost data and comparison. Tables 47 and 48 in this chapter provide the best numerical summary of the research results. The research was successful in detailing costs at NAS. Comparison of these costs with Site 1 was possible with some limitations. Use of data from the other sites has additional limitations. This research can be the beginning of greater research efforts. A format for comparison has been developed that can be used again in further extension of this research or extending similar studies into other commodities. The next chapter summarizes the research and offers suggestions for areas of future research.

VII. SUMMARY AND FUTURE RESEARCH AREAS

A. SUMMARY

The background of the research was provided in Chapters I, II, and III. Chapter I presented the research questions and scope limitations. Chapter II discussed the nature of the fiscal environment and the Navy's strategy to meet the challenges of the future. Navy facility management was reviewed in a historical perspective introducing recent DMRD initiatives impacting PWCSB operations. Site and budget background closed out Chapter II. A presentation of the methods by which material was collected for the research was provided in Chapter III. Chapters IV and V presented NAS and three non-DoD site data respectively. Chapter VI presented the unit cost comparison that was the major objective of the research. This chapter concludes the thesis with the summary and recommendations for further research. The major findings of the research are reviewed below.

PWCSB's electrical procurement costs for NAS Alameda and other customers are not competitive with two other non-DoD sites, questioning the rate structure of electrical utility companies charging Navy accounts. If Site 1 and Site 2 are representative of the greater local non-DoD sector, electrical procurement costs are 10% to 35% higher for the Navy on a unit cost basis. Electrical distribution costs are also high for NAS, 410% in excess of Site 1; but the research is inconclusive as to the magnitude or existence of potential inefficiencies because the impact of a new distribution system at Site 1 on lower maintenance requirements cannot be determined.

Water procurement costs incurred at NAS are favorably priced. NAS water distribution costs exceeded Site 1's costs by 317% despite having a newer distribution system. The pattern from comparisons of NAS to Site 1 data suggests PWCSB may be labor intensive performing more preventative maintenance work without realizing comparatively lower repair costs in comparison.

The appendixes provide greater analysis by providing various trend data and recommendations. Accounts are identified for future cost reduction efforts. Electricity consumption usage is provided by major tenants. Overtime labor use is also reviewed to target overtime reductions. The question and answer survey provided in the appendix has miscellaneous information that is not discussed in the text of this thesis.

Partnership with the local community has resulted in a valued experience that should continue to be fostered. The results of this research are largely impacted by what additional networking will occur. The Navy should take the lead and identify areas that research participants may be interested in for further cooperative efforts. The research identified further areas for research provided below.

B. FUTURE RESEARCH

1. Networking

This research provides unit cost data for four sites. Absent future networking, Chapter VI provided some considerations that influence data comparison. Site managers are expected to better evaluate their costs and determine why unit costs compare favorably or unfavorably to other sites. Non-DoD sites provided incomplete data. Maybe better data could be obtained in the

future to fill in the data "holes". These research results can be completed and the research benefits can be completely evaluated. Time and data constraints limited this study.

2. Budgeting Techniques

Other PWCs showed interest in research surveying the private sector and investigating the use of algorithms. Lack of NAVFAC funding prevented research in any area but the local area. Other PWCs expressed an eager desire for research into the utility company rate making process for finding ways to streamline and validate the process. The sites of this research did not use algorithms or other more sophisticated budgeting techniques than used by PWCSB. Utility companies may use more sophisticated techniques or algorithms. Research could compare budgeting techniques used by utility companies and those used by PWCs or create algorithms that can be used.

3. Centralized Versus Decentralized Utility Procurement

The Navy procures utilities centrally. For example, WDIV negotiates all utility contracts for PWCSB. WDIV negotiates with 103 suppliers and manages 350 utility service contracts totaling $180 million for Navy installations in the western states. The Air Force and Army procure utilities in a decentralized fashion. Does the Navy recognize any gain with centralized procurement policies? This research saw no particular reason to believe centralized procurement results in lower procurement costs. Economies realized by central procurement are largely unknown because no comparative data exists internal to the Navy. The only gains WDIV might realize in central procurement is the ability to enter into consulting contracts that review revenue recognition and rate structures of utility companies which might otherwise be too costly for an

individual command to invest. Research comparing interservice procurement costs in the same regional geographic areas would be beneficial in determining which procurement policies are resulting in lower procurement costs.

4. Social-Economic Costs of Government Contracting

PWCSB electrical unit procurement costs were higher than other non-DoD sites. Why might this exist? Government contracting often has social-economic considerations which provide social benefits, such as incentives to Small Disadvantaged Businesses, that private enterprises do not provide. Where utility procurement contracts are negotiated, how do utility procurement contracts and rates differ between DoD and non-DoD facilities? Research quantifying the cost of government contracts as a result of social-economic considerations could be beneficial.

5. Alternate Sources for Electricity

PWCSB procures 100% of its electricity needs at NAS Alameda from a commercial concern. PWCSB could potentially reduce costs if it generated some of its own electricity. Alternatives to commercial procurement include leasing cogeneration plants, partnering with private industry for cogeneration, and procuring turbine generators. Major obstacles exist in generating electricity including: gaining Congressional funding, opposition from special interest groups, requirement for third party funding, environmental issues, and Navy policy of purchasing from commercial suppliers. Other Navy attempts in the past to operate a cogeneration plant have been unsuccessful. Research into innovative procurement arrangements with the private sector that would yield lower procurement costs could be beneficial.

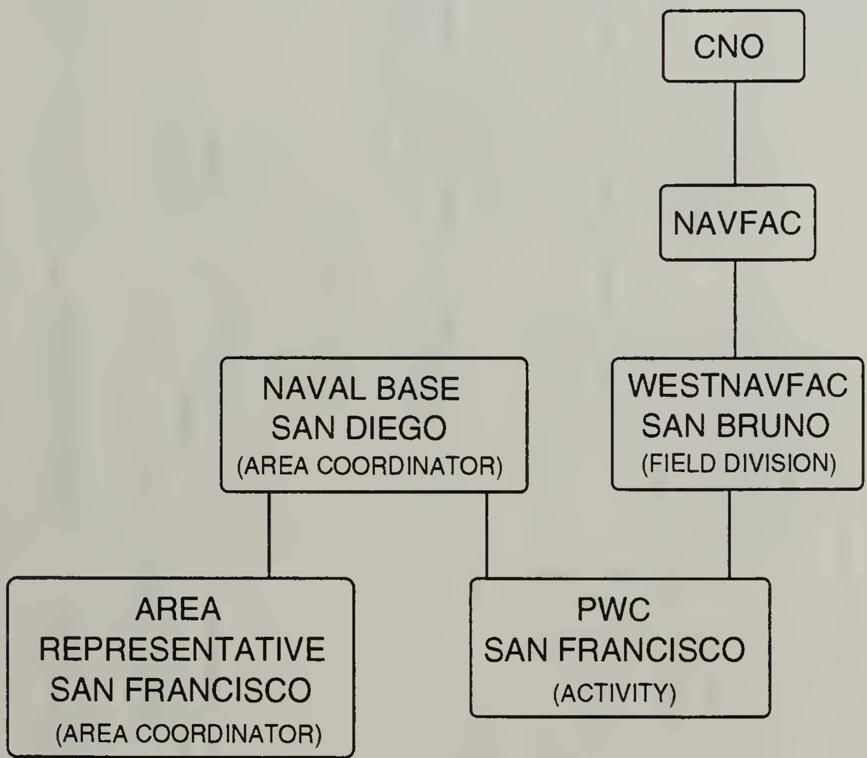
6. Further Utility Unit Cost Comparisons

Resources limited this research to electrical and water utilities at NAS Alameda. An average of three CEC officers report to the Naval Postgraduate School every quarter. A resource pool exists in which PWCSB can gain further research in other utilities or expand this research to include other sites. A framework for research is provided by this research. Continued research to compare other utilities to the non-DoD sector could be beneficial.

7. Review Coopers & Lybrand Findings

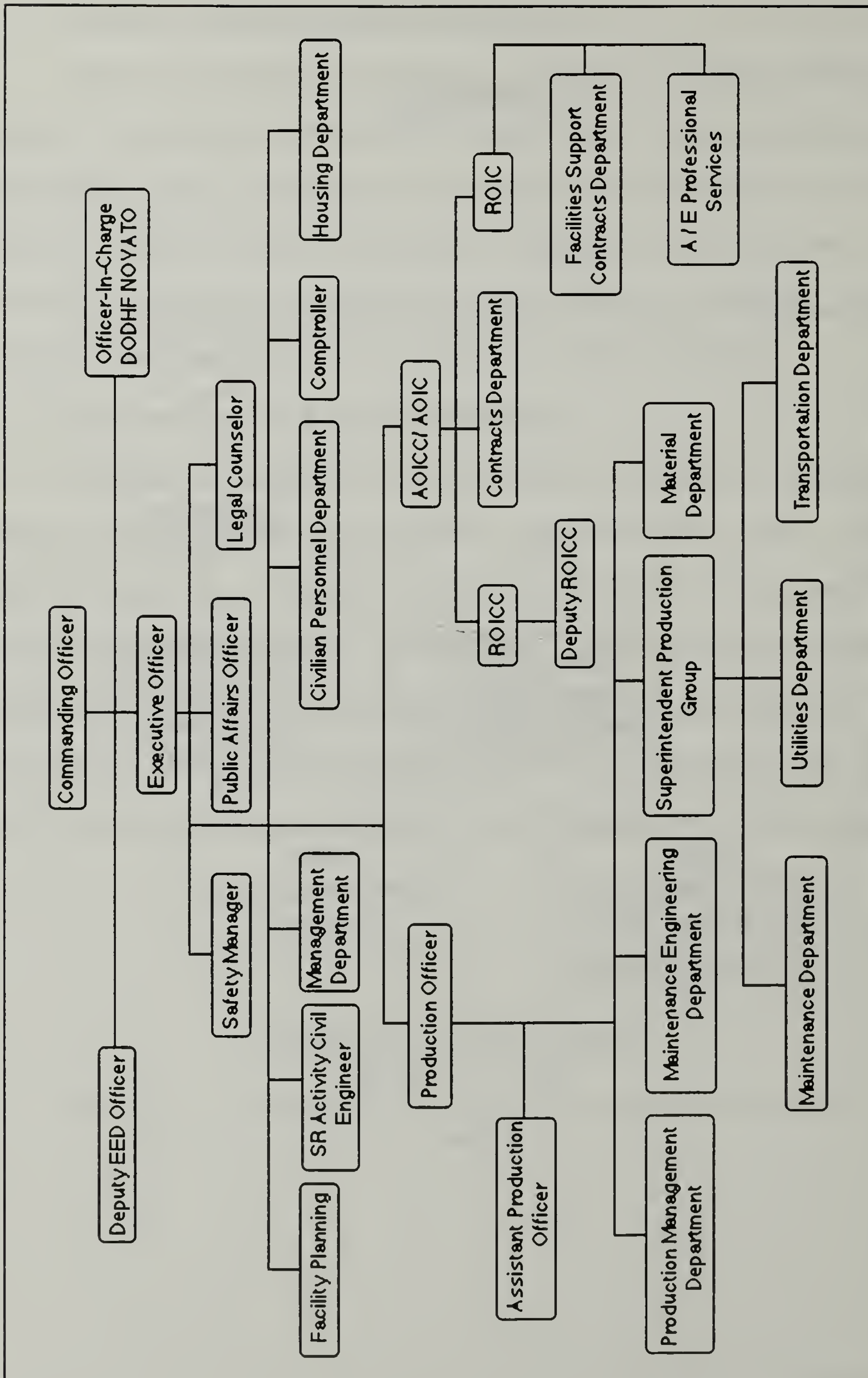
Chapter II introduced the 1986 study of Coopers & Lybrand which focused on management and operations control of Navy PWCs. Numerous problems were noted. Many of the problems still hinder the competitiveness of PWCs in providing services to its customers. What problems still hinder PWC operations and what are the obstacles that have prevented progress? The TQL environment searches for continued improvement. Research could review the Coopers & Lybrand findings and report on the effectiveness of Navy actions.

APPENDIX A



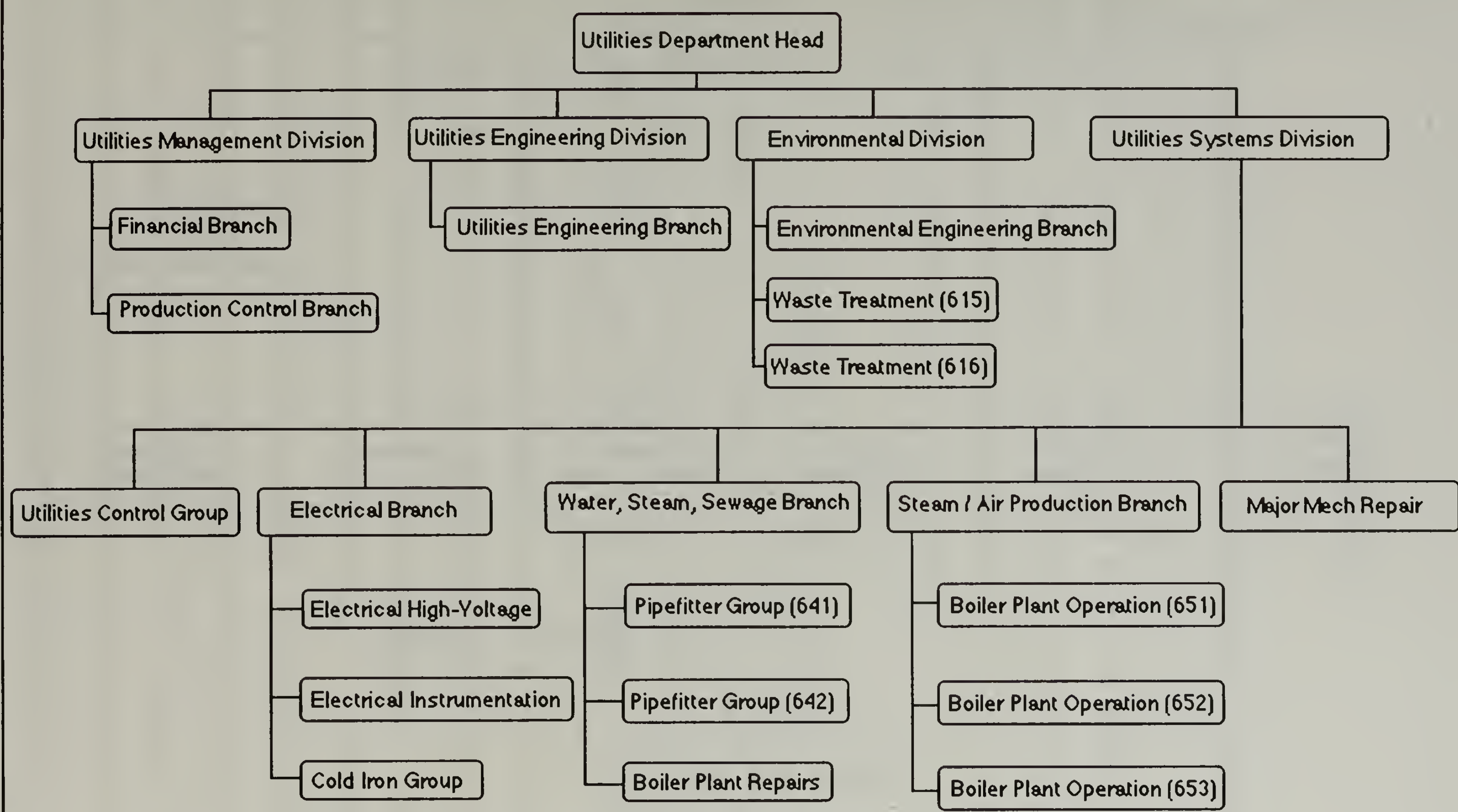
PWC CHAIN OF COMMAND
[Ref. 4: p.C-4]

Figure 1



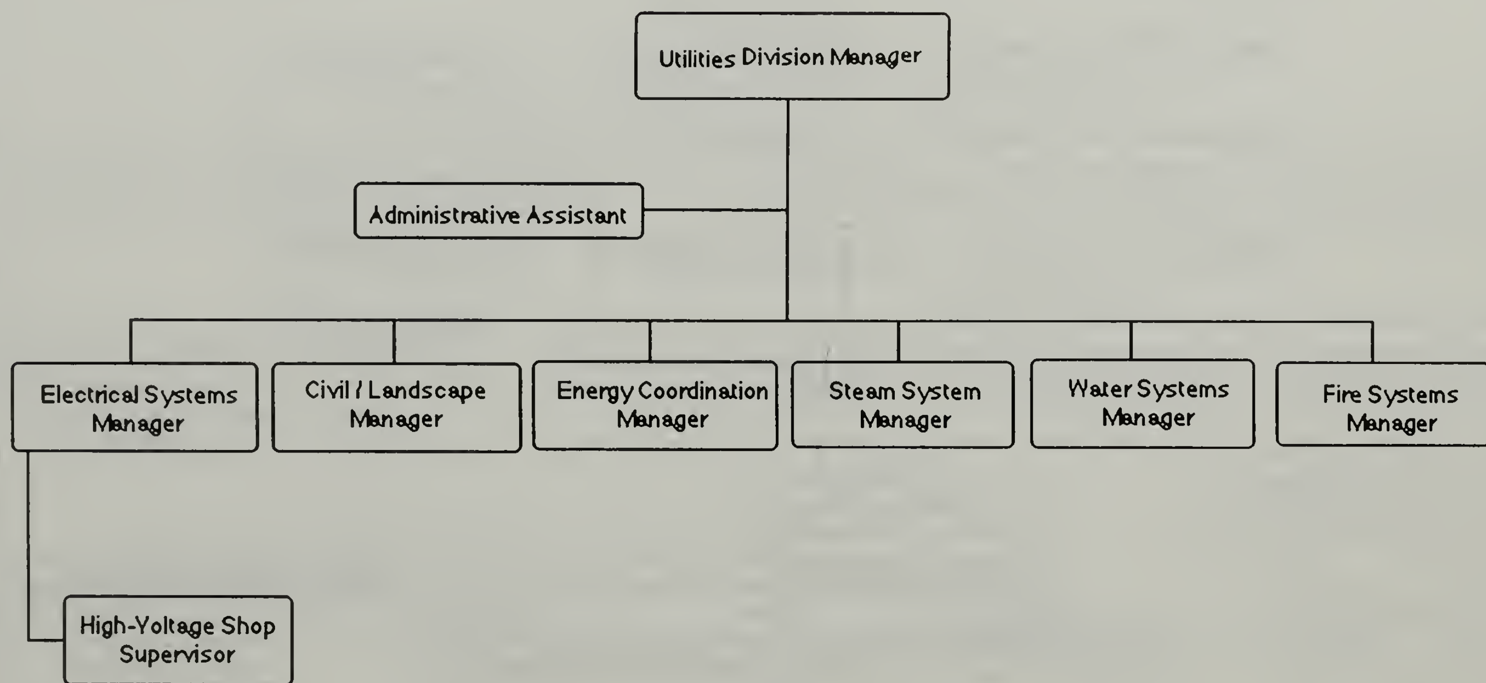
PWCSB ORGANIZATION [Ref. 4: p.C-5]

Figure 2



P WCSB UTILITY DEPARTMENT ORGANIZATIONAL CHART

Figure 3



SITE 2 UTILITY DEPARTMENT ORGANIZATIONAL CHART

Figure 4

APPENDIX B

A. PWCSB CUSTOMER CONSUMPTION ANALYSIS; ELECTRICITY

By comparing all of PWCSB's user consumption results to NAS Alameda, the source of PWCSB's electricity procurement savings is realized. NAS Alameda accounts for the total savings in PWCSB's electricity procurement. Other bases in the aggregate have increased their demands while NAS has decreased their demands. See Table 49 below for a cost summary.

TABLE 49

CONSUMPTION COSTS SUMMARY

Customer	FY 89	FY 91	Annual Change
Alameda NAS	$11,584,050	$10,181,347	$701,352 down
All other PWCSB	$9,174,664	$10,328,947	$577,142 up

Source: WDIV Utilities Procurement Report; FY 89 and 91

The net PWCSB procurement savings has been driven by reduction in usage and costs at NAS. Total usage of PWCSB's customers decreased 4% or approximately 10,987 MWH/year over the three year period. NAS has decreased consumption over the period by 13,926 MWH/year or 4% representing the entire conservation effort by PWCSB. Where aggressive conservation, load management, partnership, and other efforts at NAS has saved $701,352/year, the other bases costs have increased by $577,142/year "stealing" 82% of potential savings. Where NAS represented 56% of the total PWCSB electricity procurement costs in FY 89, they represented 50% of the costs in FY 91. Efforts similar to those at NAS should be considered at the locations listed in Table 50

according to their listed rank. If the average annual increase could be halted in the accounts listed below, a potential annual savings of over $662,000 exists.

TABLE 50

TOP ELECTRICITY CONSUMPTION ABUSERS DURING FY 89 - 91

RANKED BY AVERAGE YEARLY PROCUREMENT COST INCREASE

Customer	Avg. Annual Increase	Avg. Usage Increase
Mt Blvd NRMC Oakland (N62474-67-C-0138)	$409,989	469 (MWH)
1501 Maritime OAB (N62474-74-C-7194)	$144,165	1,171 (MWH)
Treasure Island (N62474-84-C-0004(G))	$62,647	994 (MWH)
Main Hamilton AFB (N62474-76-C-6508)	$29,526	103 (MWH)
Western Division NAVFAC (N62474-67-C-0126)	$15,678	48 (MWH)

APPENDIX C

A. NAS ELECTRICITY PROCUREMENT; AVERAGE ANNUAL SAVINGS BETWEEN FY 89 AND FY 91

A summary of the average annual changes affecting savings is shown in Table 51 below. A net average annual savings has been realized in electricity procurement costs at NAS. Four of the six categories listed below is largely the result of billing structure. Only peak demand conservation is a result of the direct efforts of PWCSB or NAS. Of the savings realized, about 40% is contributed directly to decreasing peak demand consumption. The other 60% savings is contributed most to lower fuel cost adjustments.

Fuel cost adjustments decreased at a faster rate than actual consumption decreases indicating the rate structure may have provided some of the savings in fuel cost adjustments instead of decreased peak demand. The decreases in fuel cost billings is essentially equal to the energy charge increases. Considering the rate structure changed in February FY 90, about midpoint in the three year period of study, the rate structure shifted the burden of cost from fuel cost adjustments (largely related to peak demand) to total energy usage. Also the combination of the energy demand cost and fuel cost adjustments represented consistently about 60% of the total billings during the three period indicating further a shift in the burden of cost occurred. The point to be made is that not all of the fuel cost adjustments should be claimed to be the result of lower peak demand. The method of calculation for fuel cost adjustment billings are hidden in the billing structure. A more open billing mechanism by the Bureau could help in managing

costs. A summary of the annual savings between FY 89 and FY 91 is provided below.

TABLE 51

AVERAGE ANNUAL PROCUREMENT SAVINGS FY 89 - 91

SAVINGS REALIZED	$	%
Peak conservation	$280,500	15%
Fuel costs billing decreases	$1,422,141	76%
Base line subsidies billing decreases	$178,800	9%
Total savings realized	$1,881,241	100%
SAVINGS LOST/COST INCREASES		
Energy charge billing increases	($1,142,418)	97%
Voltage discount billing reductions	($25,839)	2%
Power factor billing	($11,034)	1%
Customer charge	(600)	~0%
Total savings lost	($1,179,891)	100%
TOTAL AVERAGE ANNUAL SAVINGS	$701,350	

APPENDIX D

A. NAS TENANT USAGE ANALYSIS

1. The Commodities

a. Electricity

By reviewing PWCSB's NAS Alameda's year end Tally sheets for FY 89, 90, and 91, NAS's tenants trends of electrical consumption were determined for a three year period. NADEP and ships of CINCPACFLT are the two largest users of electricity at NAS consuming an average of three fourths of all electricity. Of approximately 153 line item accounts representing mostly buildings, ten line item accounts represented about three fourths of electricity consumption. See Table 52 below. These are the accounts that can yield the greatest benefits in conservation efforts and peak demand control. Half of these ten accounts are NADEP facilities. Although the average annual consumption decrease in the five NADEP accounts averages about 7.6%, the total NADEP consumption trend is stable representing gains are apparent in other accounts. CINCPACFLT's consumption trend is generally decreasing with an annual percentage rate of 19% and accounts for the bulk of consumption savings at NAS. The three year trend data is presented below in Tables 53, 54, and 55.

TABLE 52

TOP TEN ELECTRICITY CONSUMPTION USER ACCOUNTS AT NAS BY AVERAGE MONTHLY CONSUMPTION (MWH)

Facility	3 Yr. Av	FY 89	FY 90	FY 91	Annual Change
Ships, CINCPACFLT	3,829	5,331	2,878	3,278	19% down
Bldg 5, NADEP	1,183	1,201	1,329	1,018	8% down
Misc. Bldgs, NAS	859	690	754	1,134	32% up
Bldg 400, NADEP	709	653	799	674	2% up
Bldg 399, NADEP	616	600	862	385	18% down
Bldg 552, NADEP	579	580	630	526	5% down
Bldg 62, NARDAC	515	529	547	469	6% down
Bldg 530, NADEP	417	397	526	328	9% down
Bldg 10, Air Comp	384	403	421	327	9% down
Bldg 152, Commissary	217	N/A	207	227	N/A

Source: PWCSB Tally Sheets; FY 89, 90, and 91

The account NAS Alameda - shown above as Misc. bldgs, NAS - is an account that includes miscellaneous buildings numbering approximately 45. The exact number of buildings and specific buildings were not available. The increasing trend in consumption should be a concern and investigated by management as an average annual rate of change of 32% is significant. The Commissary usage data was incomplete for FY 91. For FY 91 the Commissary did not make the top ten user consumption list but was replaced by Hanger 10 MMF with an average monthly consumption of 461 MWH. For every additional 1% decrease in consumption in the ten accounts listed above, approximately

$80,287 of savings could had been realized in annual electricity procurement costs.

TABLE 53

MAJOR TENANTS' PERCENTAGE OF TOTAL NAS ELECTRICAL USAGE

NAS Tenant	FY 89	FY 90	FY 91	3 Yr. Avg.
NADEP	31%	46%	35%	37%
CINCPACFLT (ships)	41%	25%	28%	31%
NADEP & CINCPACFLT	72%	71%	63%	69%

Source: PWCSB's Tally Sheets

The percentages in Table 53 above were calculated by dividing the "subtotal" average monthly consumption shown in Table 54 by the "average" monthly consumption as reported on the fiscal year Tally sheets. Line loss is not factored into the percentage calculations and has negligible impact on the percentages calculated.

TABLE 54

MAJOR TENANTS' AVERAGE MONTHLY USAGE (MWH)

Tenant	FY 89	FY 90	FY 91	Annual Change
NADEP	4,031	5,376	4,046	< 1% up
CINCPACFLT	5,331	2,878	3,278	19% down

Source: PWCSB's Tally Sheets; FY 89, 90, and 91

Using the data above in Table 54 to put usage in terms of annual dollars, a three year PWCSB average of $71.88/MWH is applied and presented below in Table 55.

TABLE 55

AVERAGE ANNUAL COST AT THREE YEAR AVERAGE OF $71.88/MWH

Tenant	FY 89	FY 90	FY 91	Annual Savings
NADEP	3.477	4.637	3.490	Zero
CINCPACFLT	4.598	2.482	2.827	0.885

Source: PWCSB's Tally Sheets; FY 89, 90, and 91. (MILLION/$)

APPENDIX E

A. PWCSB CUSTOMER CONSUMPTION ANALYSIS; WATER

By reviewing PWCSB's NAS Alameda's year end Tally sheets for FY 89, NAS Alameda's tenants water consumption was determined. FY 90 data was not available and FY 91 data was too incomplete. The water data discussed below is based on only one year's data.

NADEP is the largest user of water at NAS consuming about half of all potable water at NAS. Of approximately 110 line item accounts representing mostly buildings, ten line item accounts represented 86% of water consumption. These are the accounts that can yield the greatest benefits in conservation efforts. Half of these ten accounts are NADEP facilities. Two housing accounts accounted for 17% of water consumption. For every 1% decrease in consumption in the ten accounts listed above, approximately $6,832 of savings could had been realized in water procurement costs. Table 56 lists the ten accounts with the highest consumption on an average monthly basis.

TABLE 56

TOP TEN WATER CONSUMPTION USER ACCOUNTS FY 89

BY AVERAGE MONTHLY CONSUMPTION (KGAL)

Facility (ranked order)	Usage (KGAL)
Bldg 400, NADEP	7,957
Bldg 5, NADEP	7,702
Housing, ID #154435	4,473
Bldg 10, Boiler Plant	4,123
Housing, 292 units	3,959
Misc. bldgs, NAS	3,346
Ships, CINCPACFLT	3,114
Bldg 398, NADEP	2,500
Charges not to specific bldgs, NADEP	2,317
Bldg 530, NADEP	2,246

Source: Tally Sheet; FY 89

APPENDIX F

A. PWCSB ELECTRICITY UNIT PROCUREMENT COST ANALYSIS

The discussion in Appendix B, C, and D analyzes NAS Alameda's electricity procurement costs. Further comparison can be made by comparing PWCSB's electricity procurement costs from the Alameda Bureau of Electricity and its other electricity suppliers. PWCSB procures electricity from the Bureau for NAS Alameda and NAS Alameda Annex and from PG&E and the Western Area Power Administration (WAPA) for its other customers. Comparisons between procurement sources for PWCSB are provided below in Table 57.

TABLE 57

PWCSB UNIT COST OF ELECTRICITY BY PROCUREMENT SOURCE

Source	FY 89	FY 90	FY 91	Annual Change
PG&E	$69.94	$73.57	$77.51	3.6% up
Bureau for NAS Alameda	$70.34	$71.24	$74.41	1.9% up
Bureau of Electricity (1)	$70.63	$71.29	$74.24	1.7% up
WAPA	$36.78	$38.15	$38.37	1.4% up
Composite Rate	$67.05	$68.31	$71.31	2.1% up

Source: WDIV's Utilities Procurement Report; FY 89, 90, and 91
Note 1 : Includes NAS and NAS Annex

The Alameda Bureau of Electricity supplies 56% of PWCSB's requirement. PG&E and WAPA supply 33% and 11% respectively. No consumption data existed on some of the secondary accounts for NSC Oakland, Point Molate, Treasure Island, and Novato so were not included in the data; however, their net

dollar effect averaged less than 1% and is considered negligible. The Bureau indicates it prices electricity to the Navy to be competitive with PG&E. Without looking at external sites, the Bureau gives the impression of competitive rates. PG&E was 2.3% more expensive on a unit cost basis over the three years than the Bureau. Analysis between the Navy and Sites 1, 2, and 3 indicate that the Navy procurement costs may be high in comparison to the local non-DoD sector requiring further investigation and research.

APPENDIX G

This appendix identifies the work centers using the most overtime in cost center 620 and also identifies work centers with trends of increasing overtime usage. Table 58 below is a three year summary of overtime for cost center 620 on all utility distribution systems. Data cannot distinguish overtime distribution between utility commodities or customers.

TABLE 58

OVERTIME SUMMARY COST CENTER 620

	FY 89		FY 90		FY 91	
Code	Hrs	$	Hrs	$	Hrs	$
600	144	2921	275	5329	42	1026
601	3617	80270	3823	99019	3835	113964
610	710	14459	397	8581	91	2131
613	256	6571	72	1606	79	2045
614	76	1757	33	889	82	2393
615	6362	157547	6570	174301	2486	72169
620	80	3013	45	1874	0	0
621	5478	152608	5083	153752	4016	126528
625	0	0	0	0	8778	272501
630	26	1017	141	5970	96	4046
631	7293	207965	5164	150790	2795	89223
632	3405	98739	2380	73359	2107	68378
633	3714	105603	2915	84475	2646	83316
640	125	5078	164	6262	18	800
641	4353	107143	5767	151196	2274	66573
647	2620	73205	2064	58669	822	25635
650	24	1050	68	2835	12	643
651	2626	70270	3334	89427	1839	50858
652	1576	41299	1998	54721	749	18870
653	946	17631	797	14003	279	1602
TOTAL	43431	1148146	41090	1137058	33046	1002701

Source: Report 5Q06A FY 89, 90, and 91

The average annual decrease in overtime direct labor hours is 5,192 or 12%. The average annual savings realized in decreased overtime is $72,725 or 6%. The overtime time hours as a percentage of total labor hours during FY 89, 90, and 91 respectively was 11.6%, 11.3%, and 9.1% respectively. As a percentage of total labor dollars, overtime during the same period was 14.3%, 13.8%, and 11.0% respectively.

Most work centers experienced decreasing usage of overtime during the three year period; however, some codes increased overtime usage during the period. Further research into these work centers could curb labor costs. The work centers that experienced the largest overtime increase by percentage change of direct labor hours were (1) work center 601 Utilities Management Division, (2) 614 Environmental Engineering Branch, and (3) 630 Electrical Branch. The biggest users of overtime are identified below:

- 625 Major Mechanical Repair (14 personnel)
- 621 Utilities Control Group (14 personnel)
- 601 Utilities Management Division (24 personnel)
- 631 Electrical High Voltage Code (19 personnel)
- 633 Code Iron Group Code (11 personnel)

Overtime on the electrical distribution includes overtime from cost center 620 as well as other cost centers. Since work center 620 represents 85 - 90% of the direct labor hours on the electrical distribution system, the data above can broadly be assumed to be representative of the work on the electrical distribution system at NAS for purposes of trend data. The other 10 -15% is primarily performed by work center 400 and 500.

APPENDIX H

The following are a list of questions used in surveying all sites. Each sites' answers is provided with the question. Questions were asked verbally and recorded. Sites then reviewed them confirming and adjusting answers in writing as required.

1. **When does your budget year start?**

PWCSB: 1 October

Site 1: 1 July

Site 2: 1 September

Site 3: 1 January

2. **What were the total actual direct labor hours (DLHRS) on the electrical and water distribution system for each of your three budget years of 1989, 90, and 91?**

PWCSB: Two methods can be used to secure the data. Assumptions can be made to obtain an estimate with a fair degree of accuracy. The 3A77 provides DLHRS on work not charged at the Pre-Determined Rate. DLHRS, for work costed by pre-determined rates using a DLHR base, can be calculated (i.e. Emergency/Service). DLHRS for work costed by predetermined rates using non-DLHRS as a base (i.e. Engineering Services) can not be calculated. Therefore DLHRS was calculated by assuming a $20/hr wage rate and applying that to the labor cost. The labor cost is arrived at from applying budgeted percentages for direct material, direct labor, and overhead. The total direct labor hours is displayed at the bottom of Figures 8 - 10 and 14 - 16. The second method to obtain the data was by use of internally prepared spreadsheets indicating DLHRS by utility commodities for the 5 series accounts (utility accounts). This method though is the hours for all customer sites, not just Alameda and the hours probably include work that wasn't included in method 1 (i.e. Refuse, Pest and Weed, or Hazardous Waste Removal).

The different methods produce different numbers obviously and both are included below.

Site 1: Data was not available directly. An assumed average wage rate of $17.57 was applied to the sum of direct labor dollars for FY 90 and 91 to arrive at an average annual usage of labor in hours. The $17.57 wage rate that was assumed was based on the prevailing wage rate for 1992.

Site 2: Data is not collected to determine direct labor hours; however, some estimates can be made. One estimate could be based on the High Voltage Shop budget plan dated 16 July 1992. Total monthly activity manhours budgeted for the shop was determined to be 16,416 manhours. This is the manhours required to perform the work requirements of the shop. After subtracting coffee breaks, holidays, meetings, sick time, vacation, GPI project construction, material ordering, material receiving, safety meetings, training meetings, PTO, and supervision; the remaining hours left for the distribution system are about 50% of the budgeted manhours or 7,165 hours. Due to manpower availability, only 14,383 total manhours are available. If the assumption is made that 50% of these hours are for the distribution system, about 7,165 manhours of work is performed on the distribution system. More hours may be worked on the electrical distribution system to the extent other shops perform maintenance but this is minimal. Also because of manpower shortages, personnel probably spend more hours on the distribution system than is indicated by the 50% assumption. Another estimate was made based on the FY 92-93 budget preparation. Billable hours was determined to be 10,034 in total. The total was arrived at approximately by taking 79% of total annual manpower available (6.17 personnel at 2,080 hours per year). The latter method is presumed to be the better estimate. Data is incomplete for water. About eight plus hours of overtime are used every weekend to work on fluoride stations.

Site 3: The hours included below on the electrical distribution system represents the sum of three accounts; Facilities, 12KV, and 480V. Facilities represents about 80% of the sum according to management estimates. About 40 hours/year and 250 hours/year account for the 12KV and 480V system respectively or about 20% of the total. The hours provided below are 20% of the hours management provided.

TABLE 59

DIRECT LABOR HOURS SUMMARY

Sites	FY 89	FY 90	FY 91
ELECTRICITY			
PWCSB (NAS)	35,115	23,430	23,574
(ALL)	80,552	74,891	69,475
SITE 1	UNK	~15,643	~10,983
SITE 2	~10,034	~10,034	~10,034
SITE 3	378	338	250
WATER			
PWCSB (NAS)	27,543	11,368	11,823
(ALL)	65,532	88,017	51,832
SITE 1	N/A	~9,546	~8,684
SITE 2	N/A	N/A	N/A
SITE 3	1,190	1,064	800

3. Are laborers unionized?

PWCSB: Yes, laborers belong to the Union of PWCSB Employees

Site 1: Unknown

Site 2: Yes

Site 3: Yes, laborers belong to the Office Worker's Union, an affiliation of the AFL-CIO. The union is a collective unit of all employees. Electricians, plumbers, and other trades do not belong to a trade union.

4. What were the wage earner base rates for laborers maintaining electrical and water distribution systems for the same periods?

PWCSB: Data not available. Wage rates on 4W14 guarded by Privacy Act. Assumption must be made from appendix data. For FY 91, electrician rate was calculated to be $18.84/hr. For FY 91, plumber rate was calculated to be $17.11/hr.

Site 1: Some of the applicable skilled craft base payrates as of January 1992 are: $16.79/hr for a plumber/pipefitter, steamfitter/refrigeration mechanic,

and electrician; $18.05/hr for a plumber/pipefitter leadworker, steamfitter leadworker, and electrician leadworker; and $17.57 for an inspector/planner/estimator.

Site 2: Range of $16.52/hr through $20.01/hr during period of 1 Sept. 91 to 27 Feb. 92. The base wage rate used for budgeting for FY 92-93 is $21.56.

Site 3: Base rate is about $8.07/hr. Fringes make total pay about $12.50/hr. Average cost of laborers for planning and budgeting purposes is $10.50/hr. Laborers are low skilled incapable of qualifying as an Apprentice in a trade union upon hiring. Electricians for example can be classified as studio electricians instead of trade electricians.

5. What are overtime policies?

PWCSB: Overtime is a function of manpower availability, outages, and customer initiations for service. Overtime is targeted for 10% of total DLHRS. Overtime hours for any utility commodity could not be determined from the accounting system used. If the assumption is made that overtime on the NAS electrical distribution system is representative of all overtime performed by Cost Center 620, then trend analysis is useful and is referenced in Chapter V.

Site 1: Overtime is used as required. Overtime hours or straight time hours was not provided.

Site 2: Overtime is used for planned or unforeseen outages. Inspection maintenance is increasingly being performed on overtime hours. Overtime and straight time hours on the electrical and water distribution system could not be determined from the accounting system. However, overtime on the electrical distribution system has been budgeted for the FY 92-93 year at $24,899 estimating overtime at 6% of the total available hours or 8.3% of total billable hours. Overtime is paid at time and a half at $32.34/hr. Eight or more hours per weekend is consumed on the water distribution system for fluoride station work.

Site 3: Sixteen hours of overtime is consumed each weekend for duty. This represents less than 3% of total labor hours (15 laborers at 40 hours/week or 31,200 hours). Overtime must be approved by corporate management, a general manager.

6. **What are normal operating hours and number of shifts?**

PWCSB: Data was not provided although electricity demand at NAS usually begins to escalate about 5 a.m. to 6 a.m. peaking late morning or early afternoon before gradually decreasing throughout the afternoon with a sharper decline at about 3 p.m. or 4 p.m.

Site 1: Normal business hours, with limited support through the night.

Site 2: Normal business hours, with limited support through the night.

Site 3: Normal hours during the summer and early fall months is seven days per week between 9 a.m. and 6 p.m. A single shift is maintained. In the late fall, winter, and spring months, similar hours are maintained five days per week.

7. **Who supplies your electricity and water?**

PWCSB: Alameda's Bureau of Electricity and East Bay Municipal Utility District (East Bay MUD)

Site 1: PG&E and East Bay MUD

Site 2: A cogenerator producer. A secondary source is PG&E. Water is supplied by the City of residence.

Site 3: PG&E and City of residence

8. **What discounts are provided? What charges are levied? What incentives does the billing structure provide?**

PWCSB: Electricity discounts include voltage discounts and power factor adjustments. Charges levied include customer charges, peak demand charges, energy charges, baseline subsidy charges, and also power factor adjustments. The incentives in the billing structure are to reduce overall usage and manage peak demand. Water charges include incremental rates based on usage plus a connection fee? The incentive is to reduce overall usage.

Site 1: Electricity discounts are provided and are structured to provide incentives for conservation. Water charges are incremental and the incentive is also to conserve.

Site 2: Unknown. Data was provided in the aggregate.

Site 3: Electricity incentives are to reduce overall usage for lower costs.

9. How are customers charged and allocated procurement costs?

PWCSB: Customers are allocated electrical costs by energy usage measured by meter or estimates based on factors such as square feet, number of personnel, equipment, facility construction type, etc. Customers are charged via a pre-determined rate per MWH. The pre-determined rate includes the cost of procurement, distribution, and overhead. Pre-determined rates are based on estimated usage and costs for all PWCSB's customers in the aggregate. NAS for example is charged the same rate for electricity as all other PWCSB bases. The use of pre-determined rates does not provide an incentive for customers to coordinate or manage peak demand. Furthermore, incentive does not exist to reduce energy usage for those customers who are unmetered because of the feeling that their savings will be allocated to other users. Water allocation is principally through a computer program which estimates consumption based on factors similar to those for electrical allocation. Use of a pre-determined rate for water allocation also exists.

Site 1: Unknown in detail, similar to PWCSB in general.

Site 2: Unknown in detail, similar to PWCSB in general.

Site 3: Allocation is not made to internal customers. The Utilities Department is funded to pay all utility bills.

10. Are rates with the supplier negotiated or are rates published (regulated)?

PWCSB: Electricity rates are negotiated between WESTDIV and the Bureau of Electricity at Alameda. Negotiated rates include the regulated rate structure established by the city commission overseeing the Bureau. Rates for PG&E are published but the Navy does testify at the rate hearings. Water rates are not negotiated but published. Penalty charges were negotiated.

Site 1: Electricity rates are negotiated internally by the Utilities Department. Water rates are published but penalty charges are negotiated.

Site 2: Electricity rates are negotiated. It is unknown if water rates are negotiated.

Site 3: Electricity and water rates are paid according to published rates. Rates are not negotiated.

11. Do any unusual procurement arrangements exist?

PWCSB: Western Area Power Association (WAPA), a cheap source of power, supplies electricity to several bases served by PWCSB. Mare Island Naval Shipyard electricity needs are served 95% by WAPA. Similarly, Moffett NAS is served 99% by WAPA, Treasure Island 96%, Stockton Naval communication Station 82%, Skaggs Island Naval Security Group 97%, and Concord Naval Weapons Station 85%.

Site 1: No

Site 2: Electricity is procured from third party cogeneration producer on site. Utilities and some facilities are provided without charge.

Site 3: No

12. What internal department negotiates contracts with the utility suppliers?

PWCSB: WESTDIV negotiates the contracts thereby creating a centralized procurement policy unlike the Army and the Air Force. PWC is not charged for the cost of contract administration. WESTDIV receives funding from an alternate source. This policy is changing.

Site 1: Utilities department

Site 2: Facilities Utility Management

Site 3: Rates are not negotiated.

13. Do you have any unique uses of your electricity and water?

PWCSB: Navy ships, NADEP wind tunnel, and industrial processes

Site 1: Data not provided for confidentiality purposes

Site 2: Computer and laser cooling

Site 3: One third to half of procured water is used for landscaping. Marine uses of water is unique to the organization

14. What is the size of the system that electricity serves and water serves (number of buildings, building functions, building ages, square miles of area, acreage, miles of line, etc.)?

PWCSB: NAS Alameda is comprised of 2,720 acres of land, water, and airspace easement. NAS has 287 structures comprising 5,691,285 square feet. From the PWC Master Plan of 1985; 322,507 linear feet of electrical line are in place. Water lines were estimated to include 196,000 linear feet in a Bechtel Utility Technical study. Plant property records were provided by WDIV to examine building numbers, functions, and ages.

Site 1: Site 1 has 157 structures accounting for 5,731,905 square feet. The majority of the structures are administrative, multi-unit housing, and recreational.

Site 2: Site 2 has about 673 structures accounting for 11,809,832 square feet. The majority of the structures are administrative, multi-unit housing, laboratories, and medical in nature. The water system has 145 miles of line.

Site 3: Site 3 has 57 structures accounting for 65,940 square feet. The majority of the structures are administrative, retail, and light industrial. The 12KV electrical system has 5,400 feet of line and the 480V system has 6,000 feet of line.

15. What is the physical description of the electrical and water distribution systems?

PWCSB: Most of the industrial electric power system network is approximately 47 years old. The pier electrical network is approximately 10 years old. Other parts have been rebuilt, while still others were added to extend new loads to the system. The system is generally in good condition. Electric power is delivered by two 115-KV transmission lines connected to a Pacific Gas and Electric (PG&E) transmission system. PG&E is the regional supplier of electricity and gas in northern California and is the largest distributor of electricity in the country. Although the distribution system uses two PG&E transmission lines, electricity is supplied by Alameda's Bureau of Electricity. A City of Alameda and Navy 115-KV to 12.5-KV substation contains city 15-KV switch gear and Navy

15-KV switch gear from which 12.47 KV underground feeders supply eight of eleven substations. The other three substations are fed by interconnections to these eight stations. These 12.5-KV feeders and the interconnections between substations are operated with the circuit breaker closed to form two highly reliable primary networks. These networks will serve the distribution substations without interruption if a 12.5 KV feeder trips out. Power is further stepped down in 11 substations to either 4.16 KV or 480 V for secondary distribution. Utilization voltages are at 4.16 KV (one aircraft carrier and large motors) or at 480/277V (one aircraft carrier), 208/120V and 120/240V. Secondary radial 4.16-KV distribution feeders supply loads near the substation and are able to serve large loads without an excessive drop in voltage. To limit the expansion of the 4.16-KV system, large new loads are fed at 12.5-KV when feasible through underground cable in duct bans, except in housing areas where overhead lines are used.

The water systems not recently replaced is approximately 49 years old. A water system line replacement project for the south half of the base was completed by fiscal year 1991. Water lines were estimated in a Bechtel Utility Technical study to include 63% of cast iron, 34% asbestos-cement, 3% steel, and less than 1% copper. East Bay Municipal Utility District (East Bay MUD) supplies water through three primary feed lines entering NAS from the west, one 8" cast iron line, a 10 or 12" cast iron line, and an 8 or 12" cast iron line. Two other primary supply lines consist of an 8" cast iron line and a 12" carbon steel line. Housing south of Arnold Avenue is supplied by a 6" carbon steel line. The potable and fire protection water systems consists of a series of 6, 8, 10, 12, and 16" pipeline loops of various pipe materials. These line loops are generally located within the major streets and underneath piers. Pier systems are provided with sectional valves to isolate segments of the system during maintenance and repair. The potable water system on the Wharf and Piers consists of tar coated 6 and 8" carbon steel lines supported by hangers from the underside of the piers. The piers have 24 potable water stations. Fire protection water for piers is supplied from four booster pumps driven by two diesel driven and one electric motor driven centrifugal pumps. Fire protection water is supplied to ships at 13 stations located in the pier deck. Each station has a flush type fire hydrant and is covered by a cast-iron frame and hinged access hatch. One chlorinator system for potable water exists to chlorinate water used by ships. Fire protection water for another pier is supplied from a saltwater pumping station.

Site 1: The electrical distribution system is an underground 12KV electrical distribution system less than five years old. The last phase of construction ended in 1991. The 12KV system is a single voltage system with four substations equipped with a double bus system. Dual feeders between substations and dual subfeeders to buildings provide redundancy. The length of the electrical distribution system is estimated at more than 398,000 feet. Budget documents noted that over 350,000 feet of line was in place before construction of step 3 of the new system. From review of planning documents, the new system added an additional 48,000 feet of new cable in new duct banks while the other 48,000 feet of new cable replaced old cable in existing duct banks. The combination of the data resulted in the estimate of 398,000 feet of line. The age of the water distribution system varies in age and is as old as 100 years.

Site 2: Site 2 procures electricity from a cogenerator producer of electricity and uses PG&E as a reserve supplier when demand can not be met by the cogenerator. Water is procured from a city source. Electricity is brought to Site 2 via two 60KV lines. They terminate at the site's substation where two 16MV transformers transform the electricity to 12KV. The substation also contains a 1-5 MVA transformer for 60KV to 4160V utility service. The cogeneration power supplier located on site feeds approximately 45MW into the substation. Of the 45MW, 21MW is used on site and 24MW is sold to PG&E. Most profits of the cogenerator are obtained from the sale of electricity to PG&E. The electrical distribution system is underground. The water system includes procurement from a city source and use of well water on site.

Site 3: Site 3 procures electricity from PG&E and water from the city in which it resides. Site 3 has a 12KV loop system with no redundancy of 5,400 feet with seven substations distributing electricity at 408/480V over 6,000 feet of line. The water system has two feeds, a 12" and 8" feeding a loop system.

16. How old are the electrical and water distribution systems? What is their general state of condition?

PWCSB: Most of the industrial electric distribution system at NAS is approximately 47 years old. The pier network is approximately 10 years old. Other parts have been rebuilt, while still others were added to extend new loads to the system. The system is generally in good condition. The water systems are approximately 49 years old except for the south half of

the base where two water system projects were recently completed. The frequency of water breaks is unknown.

Site 1: A 115KV distribution system was just installed and is less than five years old. The age of the water distribution system varies in age and is as old as 100 years. The frequency of water breaks is unknown.

Site 2: The electrical and water systems vary in age to as much as 115 years old. The systems are generally in good condition. The frequency of water breaks is unknown.

Site 3: The electrical and water distribution systems were installed new about 7 years ago. Their conditions are in good order.

17. Does preventative maintenance exist?

PWCSB: Yes. PWCSB maintains a structured program that indicates when hardware should be checked. Laborers provide feedback to alter the program as required. A automated system called ARMS is being installed. 3A77 CODES 5114602, 604, and 606 are the preventative maintenance accounts for the electrical distribution system at NAS. Similarly, the preventative maintenance accounts for water are 5154514, 604, and 606.

Site 1: Yes although a structured program does not exist.

Site 2: A work plan is established for preventative maintenance.

Site 3: Maintenance is ad hoc in nature putting out fires. No structured preventative maintenance plan is executed. The only preventative maintenance performed routinely is oil testing on transformers done by a private contractor. The city back flows preventers about once a year. Fire hydrant maintenance is supposed to happen about once a year too but the city is not doing it.

18. Does a preventative maintenance backlog typically exist?

PWCSB: For the most part no backlog exists, not appreciably anyway. Availability of manpower affects any backlog. The targets each year for scheduled maintenance is 80% execution.

Site 1: Preventative maintenance backlog does not exist. Because of the construction of our new electrical distribution system, maintenance requirements have been put off.

Site 2: Preventative maintenance does have a backlog for electrical work of while the water system maintenance backlog is largely unknown.

Site 3: Not applicable because preventative maintenance on the 7 year old electrical system is not a priority.

19. What percentage of planned preventative maintenance was unexecuted during the year ends?

PWCSB: Data is too difficult to retrieve on the data base for PWCSB, but is estimated to be approximately 20%.

Site 1: Zero

Site 2: Because of personnel cuts, about 20% of preventative maintenance of the electrical distribution system is unexecuted. Water system is unknown

Site 3: Not applicable

20. How is maintenance work generated?

PWCSB: Work is generated by the preventative maintenance plan, self generated from system operators, and generated from customers via E/S chits and staff civil engineers. System equipment is inventoried and input to a mainsaver database. Planning and estimate personnel determine maintenance requirements and work is scheduled via the mainsaver.

Site 1: Work is internally generated by the Utilities Department personnel.

Site 2: Some work is planned by the department manager and other work is generated by line workers who identify requirements.

Site 3: Work is generated by the maintenance staff and customers

21. How is maintenance prioritized?

PWCSB: Maintenance work does not require prioritizing because all work is performed. Response priority is determined by the nature of the service call if generated from customers.

Site 1: $110 million of deferred maintenance is on the books which include capital improvements. The list is prioritized for funding; when it becomes available, work can be performed.

Site 2: Blanket work orders are issued yearly and hours accounted for against them. Electrical utility equipment is reviewed and maintenance forms filled out. The engineer is informed and schedules the maintenance.

Site 3: At any one time, customers will generate work orders creating a backlog of about 100 requests ranging from changing a wall socket location to erecting a building. The Utilities Department does not determine priority of work; instead a general manager prioritizes work.

22. The amount of maintenance performed is a function of what factors?

PWCSB: Manpower availability

Site 1: Funding and customer pressures and requests

Site 2: Manpower

Site 3: Funding and manpower

23. What recent innovate measures are being taken to minimize electrical and water procurement and distribution costs?

PWCSB: TQL process teams are studying processes to reduce costs and eliminate waste. Costs are being reduced by generating less work on E/S chits which are costed at higher rates and by generating more work by Minors costed at lower rates. Electricity peak demand management control procedures are being investigated as well as partnerships with the electrical supplier to shed load costs and share cost savings. Management is seeking greater internal studies into unit costing of utility costs. PWCSB is partnering with NADEP at NAS to mutually research areas of cost reduction.

Site 1: Supplier rebates are aggressively pursued. Savings are passed onto customers in a cost sharing of 50/50. Some customers have been particularly responsive. Energy conservation is promoted to include shutting down computers when not in use.

Site 2: Energy management system controls and schedules use of building power.

Site 3: Financial assistance is being sought through the federal government by becoming a emergency utility supplier through FEMA which justifies

purchase of emergency generators. Drought resistant landscaping is used and pond fountains use recirculating water.

24. What type of work is not being performed because of budget squeezes?

PWCSB: System renovation and upgrades are being reduced. Many energy conservation projects are languishing due to lack of funding and inflexibility in using funds.

Site 1: Unknown

Site 2: Gate valve surveys, fire hydrant maintenance, and manhole maintenance and inspections.

Site 3: None

25. How is material procured, by job order or bulk?

PWCSB: Material controllers write up material, equipment, and rental requirements for all in progress work to include maintenance service calls, preventative maintenance, and emergency services. About 80% of material used for maintenance is procured from local suppliers using telephone bid and Blanket Purchase Agreements (BPSs), Indefinite Delivery Time Contracts (IDTSs), cash on delivery, and imprest accounts. In this regard, maintenance material is procured mostly by job order. Time constraints prevent ordering from the federal supply system which includes PWC shop stores, DoD, Defense Logistics Agency (DLA), General Services Administration (GSA), and other sources. Special project material is primarily purchased through the federal supply system (65%) when time is more available permitting one to six months of lead time. Otherwise the other 35% is acquired locally as described above.

Site 1: Materials are bought through an internal separate purchasing division.

Site 2: Electrical material is bought through the electrical department's funds and stocked in inventory until needed. Water repair materials are bought from an internal purchasing division who buys by stock.

Site 3: Material is procured by job order using telephone bid. Many suppliers are used but generally only one supplier will be called to receive a quote.

26. **What are the relationships with suppliers? What type of contracts are in place?**

PWCSB: IDTC's and blanket purchase agreements.

Site 1: The Utilities Department does not procure materials but is purchased by separate purchasing personnel.

Site 2: The organization's stores supplies about 12% of the Utilities Department's needs. Low bid telephone suppliers provide the remainder.

Site 3: No contracts are in place and no long-term relationships exist.

27. **How are distribution costs (repairs, preventative maintenance, capital improvements, special projects, etc.) recouped by the Utilities Department? How are customers allocated these costs if they are passed on to users?**

PWCSB: Costs are recouped by charging customers a pre-determined rate ($/MWH and $/KGAL). Capital improvements are factored in the rate making process by including future capital improvements by lump sum instead of amortizing. All customers are charged the same rate. Allocation is by meter for metered customers or engineered estimates for unmetered customers. Although billing by the electricity supplier accounts for peak demand, customer meters are not demand meters. Customers have no incentive to manage demand unless a cost sharing arrangement is originated so that they receive a benefit. Metered customers also have no incentive to conserve if they believe their savings is allocated to other users.

Site 1: Costs are funded to the Utilities Department from higher funding authority outside the immediate organization and by recharging. Recharging is similar to the pre-determined rate used by PWCSB. Allocation is made by meter and engineered estimates.

Site 2: Costs are recouped from customers using a rate similar to Site 1 and PWCSB. Capital Improvements are amortized over 15 years. Allocation is made by metering and engineered estimates.

Site 3: Costs are not recouped from customers. The Utilities Department is funded by corporate management. Customers compete against each other for the services of the Utilities Department that is prioritized by the

general manager. Utility bills are paid by the Utilities Department not allocated to customers. Customers or users have little incentive to conserve because no direct benefit is perceived.

28. What is the accounting system used to track costs, is it job costing?

PWCSB: Job order costing using predetermined rates and applied overhead

Site 1: Job costing using recharge rates and applied overhead

Site 2: Job costing using charge rates and applied overhead

Site 3: Unknown

29. How are distribution costs budgeted for in future fiscal years?

PWCSB: PWCSB annually prepares a three year budget after the Office of Management and Budget (OMB) publishes circular A-11 which sets the policy and guidance for the budget year. PWCSB's Comptroller is provided budget guidance from the Navy Comptroller and NAVFAC once OMB distributes circular A-11. The three years budgeted include the prior year (a revision of the present fiscal year based on one quarter of actual data and three quarters of estimated data), the current year (a revision of the operating costs for the following fiscal year), and the budget year (two years from the present year).

The PWCSB Utilities Cost Center manager requests budget driver reports from his subordinate managers that estimate future years' sales unit volume, workload costs (includes procurement and distribution costs), and personnel requirements. Estimates of sales volume and costs are based on historical data, experience, and considerations to projects scheduled for future years. Staffing requirements are based on historical work load and backlog. Staffing requirements for plant operations and overhead positions are established using zero base budgeting methods. Labor costs include an acceleration rate provided from PWCSB's Comptroller. Project costs historically have not been amortized but included in lump sum fashion into a subsequent fiscal year for rate making purposes. Cost elements estimated by cost center managers include direct labor, direct material, applied overhead, projects, interutility transfers, contract fees, transportation equipment rental, Emergency service chits, hazardous waste surcharge, refuse, miscellaneous small

contracts, pest control, applied overhead, and other costs. Many of these costs are costed at a predetermined rate to include applied overhead. All predetermined rates are provided to cost center managers by the PWCSB Comptroller through trial budget data. Cost center managers then determine the break even rate and propose rates for the A-11 budget to the budget review board. The Budget Review Board membership includes the Executive Officer and Commanding officer. Changes are frequently made by the board and are forwarded to NAVFAC for review and further modification. NAVFAC forwards the A-11 budget to NAVCOMPT before its submission to the OSD/OMB review. The OSD/OMB review determines the final rates to be charged.

Site 1: Budgeting future costs is done considering historical data and known future project costs combined with experience. An average cost to square footage is considered in new construction.

Site 2: Budgeting future costs is done considering historical data and known future project costs combined with experience.

Site 3: Budgeting future costs is historical with consideration to future project costs and experience.

APPENDIX I

A. PWCSB ELECTRICAL WORK FUNCTION QUESTIONNAIRE

The following is a list of accounts that could exist in an Electrical Utilities accounting system. Check those accounts with an X that describe work you perform and are included in the distribution costs (preventative maintenance, repairs, and capital improvements) provided to us. Check items with an O that are not included in the distribution costs provided to us. Feel free to make pen and ink notes modifying account titles to fit your electrical work functions.

X Manhole covers; replace	X Emergency service
X Meters; maint & repair	X General repair
X Meter reading	X Service & maint
X Runway lights; inspect/maint/repair	X Engineering services
X Street lights; inspect/maint/repair	X Engineering surveys
X Pier lights; maint	X Replace electrical pilot wire
X Emergency generator; maint	X Generators; maint
X Transformers; replace	X Emergency generator; maint
X Reconstruct PCB transformers	X Generators; relocate
X PCB transformers; refill	X Fence & link boxes
X Utility trucks (rental transportation)	X Switches; replace
X Utility trucks (owned transportation)	X Switchgear; replace
X Gas detectors	X Circuits; replace
X Cable; replace	X High voltage barricades
X Substations; repair & replace	X Water tower cable; repair
X High voltage cable substations; replace	X Breakers; repair
X Add electrical power to pier	X Test repair wire relays
X Street light cells; inspect/maint/repair	X Drawings
X High voltage feeder; repair	X High voltage ducts

X Abandon cables; remover	X Accident out switch
X Manholes; inspect/clean	X Seal electric vault
X Cable hose; replace	X Pier covers & fire doors
X Safe ladders	X Wire capacitor bank
X Install fence	X Repair ground grid
X Studies	X Refuse
X Contract administration	X Hazardous waste; removal
X TACAN station	X Oil switches
X Mobile utility service; maint/ops/surveys	X Vacuum switches

X Engineering & survey teams to calculate allocation for billings

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Other: PWCSB

B. SITE 2 ELECTRICAL WORK FUNCTION QUESTIONNAIRE

The following is a list of accounts that could exist in an Electrical Utilities accounting system. Check those accounts with an X that describe work you perform and are included in the distribution costs (preventative maintenance, repairs, and capital improvements) provided to us. Check items with an O that are not included in the distribution costs provided to us. Feel free to make pen and ink notes modifying account titles to fit your electrical work functions.

X Manhole covers; replace	X Emergency service
X Meters; maint & repair	X General repair
X Meter reading	X Service & maint
O Runway lights; inspect/maint/repair	X Engineering services
X Street lights; inspect/maint/repair	X Engineering surveys
O Pier lights; maint	X Replace electrical pilot wire
X Emergency generator; maint	X Generators; maint
X Transformers; replace	X Emergency generator; maint
X Reconstruct PCB transformers	X Generators; relocate
X PCB transformers; refill	X Fence & link boxes
1 Utility trucks (rental transportation)	X Switches; replace

X Utility trucks (owned transportation)

X Gas detectors

X Cable; replace

2 Substations; repair & replace

2 High voltage cable substations; replace

O Add electrical power to pier

X Street light cells; inspect/maint/repair

X High voltage feeder; repair

X Abandon cables; remover

X Manholes; inspect/clean

X Cable hose; replace

X Safe ladders

X Install fence

X Studies

X Contract administration

O TACAN station

X Mobile utility service; maint/ops/surveys

X Switchgear; replace

X Circuits; replace

X High voltage barricades

O Water tower cable; repair

X Breakers; repair

X Test repair wire relays

X Drawings

X High voltage ducts

X Accident out switch

X Seal electric vault

O Pier covers & fire doors

X Wire capacitor bank

X Repair ground grid

X Refuse

3 Hazardous waste; removal

X Oil switches

X Vacuum switches

X Engineering & survey teams to calculate allocation for billings

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Other: SITE 2

1. Rent truck with project
2. Repair yes. Large project replace is a capital expense
3. Done by Health & Safety Department. Collected by High Voltage Shop

C. SITE 3 ELECTRICAL WORK FUNCTION QUESTIONNAIRE

The following is a list of accounts that could exist in an Electrical Utilities accounting system. Check those accounts with an X that describe work you perform and are included in the distribution costs (preventative maintenance, repairs, and capital improvements) provided to us. Check items with an O that are not included in the distribution costs provided to us. Feel free to make pen and ink notes modifying account titles to fit your electrical work functions.

O Manhole covers; replace
O Meters; maint & repair
O Meter reading
O Runway lights; inspect/maint/repair
X Street lights; inspect/maint/repair
O Pier lights; maint
O Emergency generator; maint
X Transformers; replace
O Reconstruct PCB transformers
O PCB transformers; refill
O Utility trucks (rental transportation)
O Utility trucks (owned transportation)
O Gas detectors
O Cable; replace
X Substations; repair & replace
X High voltage cable substations; replace
O Add electrical power to pier
X Street light cells; inspect/maint/repair
X High voltage feeder; repair
O Abandon cables; remover
O Manholes; inspect/clean
O Cable hose; replace
X Safe ladders
O Install fence
O Studies
O Contract administration
O TACAN station
O Mobile utility service; maint/ops/surveys

X Emergency service
X General repair
X Service & maint
O Engineering services
O Engineering surveys
O Replace electrical pilot wire
O Generators; maint
O Emergency generator; maint
O Generators; relocate
O Fence & link boxes
X Switches; replace
O Switchgear; replace
X Circuits; replace
O High voltage barricades
O Water tower cable; repair
X Breakers; repair
O Test repair wire relays
O Drawings
O High voltage ducts
O Accident out switch
O Seal electric vault
O Pier covers & fire doors
O Wire capacitor bank
X Repair ground grid
O Refuse
O Hazardous waste; removal
O Oil switches
O Vacuum switches

O Engineering & survey teams to calculate allocation for billings

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Other: SITE 3

CHARGES	Oct-88	Nov-88	Dec-88	Jan-89	Feb-89	Mar-89	Apr-89	May-89	Jun-89	Jul-89	Aug-89	Sep-89
Customer Charge ($)	900	900	900	900	900	900	900	900	900	900	900	900
Peak Demand Charge ($12.50/KW)	276,000	295,500	378,000	382,500	384,000	363,000	402,000	373,500	369,000	432,000	442,500	411,000
Energy Charge ($9.59/MWH)	102,750	105,258	128,599	138,028	134,653	155,116	139,789	125,946	138,844	149,811	142,711	117,780
Baseline Subsidy	58,929	76,831	80,458	57,572	56,164	64,699	58,306	52,532	57,912	62,486	59,525	49,126
Fuel Cost Adjustment	311,787	329,274	402,291	460,573	449,313	517,594	466,451	420,257	463,296	499,899	476,200	393,009
Voltage Discount	(26,263)	(28,272)	(34,659)	(36,385)	(35,876)	(38,546)	(37,361)	(34,060)	(36,048)	(40,078)	(39,264)	(34,014)
Power Factor Adjust.	366	388	1,469	2,013	(501)	(1,002)	(3,142)	(3,380)	(3,437)	(4,499)	(3,394)	(3,578)
TOTAL BILLINGS ($)	724,469	779,878	957,059	1,005,201	988,653	1,061,762	1,026,944	935,696	990,467	1,100,519	1,079,179	934,223

Total Yearly Cost: Peak Demand $4,509,000; Energy Charge $1,579,286; Fuel Adjustment $5,189,944; Total Billing $11,584,050

Avg. Monthly Cost: Average Peak $375,750; Average Energy $131,607; Average Fuel Adj. $432,495; Average Month $965,337

USAGE	Oct-88	Nov-88	Dec-88	Jan-89	Feb-89	Mar-89	Apr-89	May-89	Jun-89	Jul-89	Aug-89	Sep-89
Peak Demand (KW)	22,080	23,640	30,240	30,600	30,720	29,040	32,160	29,880	29,520	34,560	35,400	32,880
Total Energy Demand (MWH)	10,714	10,976	13,410	14,393	14,041	16,175	14,577	13,133	14,478	15,622	14,881	12,282
AVG Daily Demand MWH (30 Day Month)	357	366	447	480	468	539	486	438	483	521	496	409
Peak Demand Cost (% of Total Billings)	38.10%	37.89%	39.50%	38.05%	38.84%	34.19%	39.15%	39.92%	37.26%	39.25%	41.00%	43.99%
Energy Demand Cost (% of Total Billings)	14.18%	13.50%	13.44%	13.73%	13.62%	14.61%	13.61%	13.46%	14.02%	13.61%	13.22%	12.61%
Fuel Cost Adjustment (% of Total Billings)	43.04%	42.22%	42.03%	46.59%	45.45%	48.75%	45.42%	44.91%	46.78%	45.42%	44.13%	42.07%
MONTHLY UNIT COST ($/MWH)	$67.62	$71.05	$71.37	$69.84	$70.41	$65.64	$70.45	$71.25	$68.41	$70.45	$72.52	$76.07

AVERAGE UNIT COST ($/MWH): TOTAL BILLING ($11,584,050) ÷ TOTAL ENERGY DEMAND (164,681) = $70.34 / MWH

NAS ALAMEDA FY 89 ELECTRICAL PROCUREMENT

Figure 5

CHARGES	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90	Sep-90
Customer Charge ($)	900	900	900	900	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Peak Demand Charge ($12.50/KW)	258,000	379,500	378,000	394,500	291,000	301,500	246,000	285,000	276,000	364,500	414,000	385,500
Energy Charge ($9.59-Jan/Feb-$29.03 MWH)	93,375	140,257	147,034	151,364	294,956	352,546	256,579	305,144	284,009	305,334	486,269	353,183
Baseline Subsidy	38,947	58,501	61,328	63,134	20,321	24,288	17,677	21,023	19,567	31,554	50,252	36,498
Fuel Cost Adjustment	311,574	468,012	490,623	505,073	153,422	183,377	133,460	158,721	147,728	176,700	281,409	204,391
Voltage Discount	(24,598)	(36,651)	(37,726)	(39,024)	(26,624)	(30,195)	(22,915)	(26,981)	(25,491)	(30,768)	(43,153)	(34,320)
Power Factor Adjust.	(2,380)	(1,507)	(1,523)	(3,166)	0	0	0	570	0	0	0	0
TOTAL BILLINGS ($)	675,818	1,009,012	1,038,636	1,072,782	734,075	832,516	631,801	744,477	702,813	848,320	1,189,777	946,253

Total Yearly Cost: Peak Demand $3,973,500; Energy Charge $3,170,050; Fuel Adjustment $3,214,491; Total Billing $10,426,281

Avg. Monthly Cost: Average Peak $331,125; Average Energy $264,171; Average Fuel Adj. $267,874; Average Month $868,857

USAGE	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90	Sep-90
Peak Demand (KW)	20,640	30,360	30,240	31,560	23,280	24,120	19,680	22,800	22,080	29,160	33,120	30,840
Total Energy Demand (MWH)	9,737	14,625	15,332	15,784	10,160	12,144	8,838	10,511	9,783	10,518	16,751	12,166
AVG Daily Demand MWH (30 Day Month)	325	488	511	526	339	405	295	350	326	351	558	406
Peak Demand Cost (% of Total Billings)	38.18%	37.61%	36.39%	36.77%	39.64%	36.22%	38.94%	38.28%	39.27%	42.97%	34.80%	40.74%
Energy Demand Cost (% of Total Billings)	13.82%	13.90%	14.16%	14.11%	40.18%	42.35%	40.61%	40.99%	40.41%	35.99%	40.87%	37.32%
Fuel Cost Adjustment (% of Total Billings)	46.10%	46.38%	47.24%	47.08%	20.90%	22.03%	21.12%	21.32%	21.02%	20.83%	23.65%	21.60%
MONTHLY UNIT COST ($/MWH)	$69.41	$68.99	$67.74	$67.97	$72.25	$68.55	$71.48	$70.83	$71.84	$80.66	$71.03	$77.78

AVERAGE UNIT COST ($/MWH): TOTAL BILLING ($10,426,281) ÷ TOTAL ENERGY DEMAND (146,349) = $71.24 / MWH

NAS ALAMEDA FY 90 ELECTRICAL PROCUREMENT

Figure 6

CHARGES	Oct-90	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	Jul-91	Aug-91	Sep-91
Customer Charge ($)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Peak Demand Charge ($12.50/KW)	316,500	412,500	390,000	393,000	393,000	348,000	363,000	355,500	231,000	228,000	259,500	258,000
Energy Charge($29.03-Jun/Jul-$25.12 MWH)	342,835	381,068	459,408	385,086	377,997	326,870	318,425	336,185	242,439	210,503	235,108	248,198
Baseline Subsidy	35,429	39,380	47,476	39,795	39,063	33,779	32,907	34,742	25,054	15,084	16,847	17,785
Fuel Cost Adjustment	198,403	220,528	265,865	222,854	218,751	189,163	184,277	194,554	140,303	155,028	173,149	182,789
Voltage Discount	(31,296)	(36,907)	(40,731)	(36,461)	(36,043)	(31,458)	(31,486)	(32,269)	(22,393)	(21,337)	(23,996)	(24,772)
Power Factor Adjust.	0	0	0	0	0	0	659	1,337	1,374	0	0	0
TOTAL BILLINGS ($)	862,871	1,017,569	1,123,018	1,005,274	993,767	867,354	868,781	891,048	618,777	588,279	661,608	683,000

Total Yearly Cost: Peak Demand $3,948,000; Energy Charge $3,864,122; Fuel Adjustment $2,345,663; Total Billing $10,181,345

Avg. Monthly Cost: Average Peak $329,000; Average Energy $322,010; Average Fuel Adj. $195,472; Average Month $848,445

USAGE	Oct-90	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	Jul-91	Aug-91	Sep-91
Peak Demand (KW)	25,320	33,000	31,200	31,440	31,440	27,840	29,040	28,440	18,480	18,240	20,760	20,640
Total Energy Demand (MWH)	11,810	13,127	15,825	13,265	13,021	11,260	10,969	11,581	8,351	8,380	9,359	9,881
AVG Daily Demand MWH (30 Day Month)	394	438	528	442	434	375	366	386	278	279	312	329
Peak Demand Cost (% of Total Billings)	36.68%	40.54%	34.73%	39.09%	39.55%	40.12%	41.78%	39.90%	37.33%	38.76%	39.22%	37.77%
Energy Demand Cost (% of Total Billings)	39.73%	37.45%	40.91%	38.31%	38.04%	37.69%	36.65%	37.73%	39.18%	35.78%	35.54%	36.34%
Fuel Cost Adjustment (% of Total Billings)	22.99%	21.67%	23.67%	22.17%	22.01%	21.81%	21.21%	21.83%	22.67%	26.35%	26.17%	26.76%
MONTHLY UNIT COST ($/MWH)	$73.06	$77.52	$70.96	$75.78	$76.32	$77.03	$79.20	$76.94	$74.09	$70.20	$70.69	$69.13

AVERAGE UNIT COST ($/MWH): TOTAL BILLING ($10,181,345) ÷ TOTAL ENERGY DEMAND (136,828) = $74.41 / MWH

NAS ALAMEDA FY 91 ELECTRICAL PROCUREMENT

Figure 7

JON's 5114-	Description	Direct Labor Hours	Direct Labor (Dollars)	Direct Material (Dollars)	Other Direct Costs	Contracts (Dollars)	TOTALS (Dollars)
NAS ALAMEDA FY 89 ELECTRICAL SYSTEM PREVENTATIVE MAINTENANCE							
602	Maintain Pier Lights	213	$3,171	$1,390	$0	$0	$4,561
604	PMI Emergency Generators	44	$668	$964	$0	$0	$1,631
606	DEIS	9,937	$161,642	$75,614	$0	$7,794	$245,049
TOTAL PREVENTATIVE		10,193	$165,480	$77,967	$0	$7,794	$251,242
Preventative Maintenance % of Total Elec. Dist. Cost		29.03%	28.08%	16.81%	0.00%	3.07%	19.05%
NAS ALAMEDA FY 89 ELECTRICAL SYSTEM REPAIRS							
512	Meter Maintenance	2,187	$33,815	$1,455	$0	$0	$35,270
513	Meter Reading	221	$2,629	$0	$0	$0	$2,629
600	Emergency Service	3,685	$80,375	$15,203	$0	$0	$95,578
605	Maintain Emergency Generators	6	$84	$0	$0	$0	$84
614	Engineering Service	1,497	$25,628	$7,471	$0	$0	$33,099
618	Minors	10,013	$174,908	$226,816	$0	$0	$401,724
631	PF Correction	2	$14	$0	$0	$0	$14
632	High Pressure Sodium Lights	8	$121	$0	$0	$0	$121
656	MUSE	117	$1,795	$31	$0	$0	$1,825
665	Pier 3 Covers	0	$0	$0	$0	$9,380	$9,380
667	Replace Oil Cutouts	20	$412	$0	$0	$0	$412
673	Contract C2-87	0	$0	$135	$0	$0	$135
680	CUBIC	4,692	$58,648	$0	$0	$0	$58,648
TOTAL REPAIR		22,446	$378,430	$251,111	$0	$9,380	$638,921
Repair Maintenance % of Total Elec. Distribution Cost		63.92%	64.22%	54.13%	0.00%	3.69%	48.46%
NAS ALAMEDA FY 89 ELECTRICAL SYSTEM CAPITAL IMPROVEMENTS							
620	Replace HV Cable	8	$75	$0	$0	$36,475	$36,550
627	Replace 4KV Sub	0	$0	$0	$0	$3,183	$3,183
634	Replace 5KV Duct	189	$2,890	$42,724	$0	$0	$45,614
670	Replace Cable Hose	659	$10,107	$6,231	$0	$0	$16,338
677	Replace Transforme	0	$0	$0	$0	$2,595	$2,595
695	Replace Transforme	47	$817	$32	$11,112	$179,546	$191,506
697	Replace Sys- Rnway	1,574	$31,476	$85,844	$0	$0	$117,321
699	Rehab/Elec/Cables	0	$0	$0	$0	$15,272	$15,272
TOTAL CAPITAL IMPROVE		2,476	$45,365	$134,831	$11,112	$237,070	$428,378
Capital Improvements % of Total Elec. Distribution Cost		7.05%	7.70%	29.06%	100.00%	93.25%	32.49%
TOTAL ELECTRICAL DISTRIBUTION COSTS		35,115	$589,276	$463,909	$11,112	$254,244	$1,318,541
NAS ALAMEDA FY 89 ELECTRICAL DISTRIBUTION COSTS							

Figure 8

JON's 5114-	Description	Direct Labor Hours	Direct Labor (Dollars)	Direct Material (Dollars)	Other Direct Costs	Contracts (Dollars)	TOTALS (Dollars)
NAS ALAMEDA FY 90 ELECTRICAL SYSTEM PREVENTATIVE MAINTENANCE							
602	Maintain Pier Lights	353	$5,473	$730	$0	$0	$6,204
604	PMI Emergency Gen	31	$452	$40	$0	$0	$492
606	DEIS	7,770	$131,872	$63,438	$0	$30,385	$225,695
TOTAL PREVENTATIVE		8,153	$137,797	$64,208	$0	$30,385	$232,390
Preventative Maintenance % of Total Elec. Dist. Cost		34.80%	33.54%	8.59%	0.00%	6.21%	14.11%
NAS ALAMEDA FY 90 ELECTRICAL SYSTEM REPAIRS							
200	Earthquake Damage	110	$1,810	$523	$0	$0	$2,333
512	Meter Maintenance	1,552	$24,274	$171	$0	$0	$24,445
513	Meter Reading	247	$3,458	$0	$0	$0	$3,458
600	Emergency Service	1,995	$41,912	$14,116	$0	$1,685	$57,714
605	Maintain Emerg.Gen	18	$288	$20	$0	$0	$308
612	Street Light Maint.	0	$0	$16	$0	$0	$16
614	Engineering Service	1,448	$29,326	$0	$0	$0	$29,326
618	Minors	8,528	$147,434	$504,902	$0	$980	$653,315
631	PF Correction	16	$345	$0	$0	$0	$345
652	Repair Electric Sys.	0	$0	$0	$0	$4,732	$4,732
667	Replace Oil Cutouts	24	$419	$0	$0	$0	$419
673	Contract C2-87	0	$0	$3,311	$0	$0	$3,311
674	Repair Switchgear	251	$3,508	$323	$0	$0	$3,831
679	Repair Ground Grid	0	$0	$0	$0	$42,003	$42,003
680	CUBIC	159	$3,493	$0	$0	$0	$3,493
TOTAL REPAIR		14,347	$256,268	$523,382	$0	$49,400	$829,050
Repair Maintenance % of Total Elec. Distribution Cost		61.23%	62.37%	70.02%	0.00%	10.10%	50.33%
NAS ALAMEDA FY 90 ELECTRICAL SYSTEM CAPITAL IMPROVEMENTS							
527	Reconstruct Xfrmr	48	$1,339	$50	$0	$1,110	$2,499
627	Replace 4KV Sub	0	$0	$0	$0	$27,490	$27,490
628	Add Electric Pier 3	32	$526	$277	$0	$0	$803
634	Replace 5KV Duct	727	$12,885	$21,320	$0	$0	$34,206
645	Replace Switches	8	$146	$0	$0	$0	$146
676	Install Fence	0	$0	$0	$0	$8,933	$8,933
677	Replace Xfrmr	2	$34	$43,725	$0	$364	$44,123
681	Replace PCB Xfrmr	0	$0	$0	$0	$154,284	$154,284
682	Replace Circuits	114	$1,880	$94,511	$0	$0	$96,391
683	Replace Cable	0	$0	$0	$0	$18,952	$18,952
684	Replace Cable	0	$0	$0	$0	$38,270	$38,270
697	Replace Rnway Sys.	0	$0	$0	$0	$159,755	$159,755
TOTAL CAPITAL IMPROVE		931	$16,811	$159,883	$0	$409,156	$585,850
Capital Improvements % of Total Elec. Distribution Cost		3.97%	4.09%	21.39%	0.00%	83.68%	35.56%
TOTAL ELECTRICAL DISTRIBUTION COSTS		23,430	$410,875	$747,473	$0	$488,941	$1,647,290
NAS ALAMEDA FY 90 ELECTRICAL DISTRIBUTION COSTS							

Figure 9

NAS ALAMEDA FY 91 ELECTRICAL SYSTEM PREVENTATIVE MAINTENANCE							
JON's 5114-	Description	Direct Labor Hours	Direct Labor (Dollars)	Direct Material (Dollars)	Other Direct Costs	Contracts (Dollars)	TOTALS (Dollars)
602	Maintain Pier Lights	89	$1,344	$565	$0	$0	$1,910
604	PMI Emergency Generators	30	$501	$43	$0	$0	$543
606	DEIS	7,668	$142,377	$102,712	$0	$1,266	$246,356
TOTAL PREVENTATIVE		7,787	$144,222	$103,320	$0	$1,266	$248,808
Preventative Maintenance % of Total Elec. Dist. Cost		33.03%	31.90%	29.68%	0.00%	1.12%	27.23%
NAS ALAMEDA FY 91 ELECTRICAL SYSTEM REPAIRS							
512	Meter Maintenance	902	$16,086	$1,134	$0	$0	$17,220
513	Meter Reading	373	$5,926	$0	$0	$0	$5,926
600	Emergency Service	1,460	$34,809	$15,495	$0	$1,514	$51,818
605	Maintain Emergency Generators	42	$741	$408	$0	$0	$1,149
607	Repair Substation	109	$2,392	$0	$0	$0	$2,392
614	Engineering Service	2,884	$62,281	$0	$0	$0	$62,281
618	Minors	7,818	$148,631	$154,113	$0	$105	$302,849
673	Contract C2-87	0	$0	$16,011	$0	$0	$16,011
679	Repair Ground Grid	0	$0	$0	$0	$1,068	$1,068
680	CUBIC	1,024	$13,750	$0	$0	$0	$13,750
TOTAL REPAIR		14,611	$284,615	$187,162	$0	$2,687	$474,465
Repair Maintenance % of Total Elec. Distribution Cost		61.98%	62.96%	53.77%	0.00%	2.37%	51.93%
NAS ALAMEDA FY 91 ELECTRICAL SYSTEM CAPITAL IMPROVEMENTS							
527	Reconstruct Xfrmr	217	$4,305	$12,153	$0	$590	$17,048
608	Replace 5KV Gear	109	$2,522	$0	$0	$0	$2,522
627	Replace 4KV Sub	0	$0	$0	$0	$41,643	$41,643
676	Install Fence	0	$0	$0	$0	$3,324	$3,324
677	Replace Xfrmr	0	$0	$0	$0	$14,710	$14,710
681	Replace PCB Xfrmr	0	$0	$0	$0	$26,696	$26,696
682	Replace Circuits	851	$16,387	$45,421	$0	$0	$61,808
683	Replace Cable	0	$0	$0	$0	$5,144	$5,144
684	Replace Cable	0	$0	$0	$0	$12,466	$12,466
695	Replace Xfrmr	0	$0	$0	$0	$5,000	$5,000
699	Replace Switch	0	$0	$0	$0	$51	$51
TOTAL CAPITAL IMPROVE		1,177	$23,214	$57,575	$0	$109,622	$190,411
Capital Improvements % of Total Elec. Distribution Cost		4.99%	5.14%	16.54%	0.00%	96.52%	20.84%
TOTAL ELECTRICAL DISTRIBUTION COSTS		23,574	$452,051	$348,056	$0	$113,576	$913,684
NAS ALAMEDA FY 91 ELECTRICAL DISTRIBUTION COSTS							

Figure 10

CHARGES	Oct-88	Nov-88	Dec-88	Jan-89	Feb-89	Mar-89	Apr-89	May-89	Jun-89	Jul-89	Aug-89	Sep-89	TOTALS	Avg/Month
Account #100 ($)	39,561	47,933	38,418	38,617	44,908	39,569	44,492	46,021	47,016	46,032	39,363	43,384	$515,313	$42,943
Account #101 ($)	13,678	14,225	11,196	12,504	14,993	13,519	10,753	757	662	552	359	240	$93,438	$7,787
Account #102 ($)	13,865	14,374	11,285	12,624	15,158	13,673	16,922	15,405	14,753	13,827	12,261	14,026	$168,173	$14,014
Account #063 ($)	5,725	7,909	7,390	7,419	3,304	5,458	7,024	7,397	7,291	6,460	7,065	7,709	$80,151	$6,679
Total Billings ($)	72,830	84,441	68,290	71,164	78,362	72,218	79,191	69,579	69,723	66,870	59,048	65,358	$857,076	$71,423
USAGE	Oct-88	Nov-88	Dec-88	Jan-89	Feb-89	Mar-89	Apr-89	May-89	Jun-89	Jul-89	Aug-89	Sep-89	TOTALS	Avg/Month
Account #100 (Thousand/Gal)	28,015	33,979	27,200	27,342	31,824	28,020	31,527	32,617	39,764	38,927	33,258	36,676	389,148	32,429
Account #101 (Thousand/Gal)	9,642	10,032	7,874	8,806	10,579	9,529	7,559	438	441	348	184	82	65,514	5,460
Account #102 (Thousand/Gal)	9,776	10,138	7,938	8,891	10,696	9,639	11,953	10,872	12,419	11,631	10,301	11,800	126,055	10,505
Account #063 (Thousand/Gal)	4,745	6,601	6,161	6,184	2,687	4,518	5,849	6,166	6,769	5,981	6,554	7,164	69,379	5,782
Total Usage (Thousand/Gal)	52,178	60,750	49,173	51,225	55,786	51,706	56,888	50,092	59,393	56,887	50,297	55,723	650,097	54,175
Avg Daily Demand (Thousand/Gal) (30 Day Month)	1,739	2,025	1,639	1,707	1,860	1,724	1,896	1,670	1,980	1,896	1,677	1,857		
MONTHLY UNIT COST ($/Thousand/Gal)	$1.40	$1.39	$1.39	$1.39	$1.40	$1.40	$1.39	$1.39	$1.17	$1.18	$1.17	$1.17		$1.32
NAS ALAMEDA FY 89 WATER PROCUREMENT														

Figure 11

CHARGES	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90	Sep-90	TOTALS	Avg/Month
Account #100 ($)	33,720	35,808	31,175	35,682	36,085	31,981	28,107	37,243	37,972	41,851	49,088	59,099	$457,811	$38,151
Account #101 ($)	188	312	239	300	214	212	190	202	243	215	219	211	$2,746	$229
Account #102 ($)	8,346	11,452	8,842	10,503	7,639	7,619	9,939	9,488	11,697	12,280	11,826	12,602	$122,233	$10,186
Account #063 ($)	5,493	5,886	5,277	6,990	6,747	6,380	6,323	5,575	6,606	5,636	5,777	7,340	$74,032	$6,169
Total Billings ($)	47,748	53,459	45,534	53,476	50,685	46,192	44,559	52,508	56,518	59,982	66,909	79,252	$656,822	$54,735
USAGE	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90	Sep-90	TOTALS	Avg/Month
Account #100 (Thousand/Gal)	35,276	37,476	32,596	33,116	33,492	29,655	26,033	34,576	35,257	38,884	40,102	48,331	424,794	35,400
Account #101 (Thousand/Gal)	48	179	102	131	51	49	28	40	78	52	30	24	809	67
Account #102 (Thousand/Gal)	8,642	11,915	9,165	9,671	6,993	6,974	9,144	8,722	10,787	11,332	9,571	10,209	113,125	9,427
Account #063 (Thousand/Gal)	5,637	6,051	5,410	6,386	6,159	5,816	5,763	5,063	6,027	5,120	4,599	5,884	67,914	5,659
Total Usage (Thousand/Gal)	49,604	55,621	47,272	49,304	46,695	42,494	40,967	48,400	52,149	55,388	54,301	64,447	606,642	50,554
Avg Daily Demand (Thousand/Gal) (30 Day Month)	1,653	1,854	1,576	1,643	1,557	1,416	1,366	1,613	1,738	1,846	1,810	2,148		
MONTHLY UNIT COST ($/Thousand/Gal)	$0.96	$0.96	$0.96	$1.08	$1.09	$1.09	$1.09	$1.08	$1.08	$1.08	$1.23	$1.23		$1.08
NAS ALAMEDA FY 90 WATER PROCUREMENT														

Figure 12

CHARGES	Oct-90	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	Jul-91	Aug-91	Sep-91	TOTALS	Avg/Month
Account #099 ($)	311	348	628	962	881	771	774	1,124	1,009	1,087	1,217	1,320	$10,432	$869
Account #100 ($)	48,801	51,789	42,851	41,880	45,412	38,609	35,623	39,419	47,293	42,649	52,423	57,257	$544,005	$45,334
Account #101 ($)	194	9,213	8,998	10,125	9,334	6,801	6,411	8,085	9,707	8,960	11,256	13,806	$102,890	$8,574
Account #102 ($)	8,881	10,026	9,118	10,225	9,427	6,837	6,436	8,158	9,799	9,048	11,366	13,938	$113,259	$9,438
Account #063 ($)	7,382	8,118	6,830	8,426	8,143	7,355	7,280	7,070	8,683	8,267	9,805	11,330	$98,689	$8,224
Total Billings ($)	65,569	79,493	68,424	71,618	73,197	60,373	56,524	63,857	76,491	70,010	86,067	97,651	$869,275	$72,440
USAGE	Oct-90	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	Jul-91	Aug-91	Sep-91	TOTALS	Avg/Month
Account #099 (Thousand/Gal)	8	39	269	544	476	387	389	677	535	594	501	560	4,979	415
Account #100 (Thousand/Gal)	39,866	42,322	34,975	34,177	37,081	31,489	29,034	32,154	35,505	31,996	29,964	32,746	411,309	34,276
Account #101 (Thousand/Gal)	10	7,423	7,247	8,173	7,523	5,440	5,120	6,496	7,197	6,632	6,356	7,823	75,438	6,287
Account #102 (Thousand/Gal)	7,150	8,091	7,345	8,255	7,599	5,470	5,140	6,556	7,266	6,698	6,419	7,899	83,889	6,991
Account #063 (Thousand/Gal)	5,918	6,523	5,464	6,776	6,544	5,896	5,834	5,662	6,693	6,365	6,083	7,049	74,807	6,234
Total Usage (Thousand/Gal)	52,952	64,398	55,299	57,924	59,222	48,681	45,517	51,545	57,196	52,286	49,323	56,078	650,421	54,202
Avg Daily Demand (Thousand/Gal) (30 Day Month)	1,765	2,147	1,843	1,931	1,974	1,623	1,517	1,718	1,907	1,743	1,644	1,869		
MONTHLY UNIT COST ($/Thousand/Gal)	$1.24	$1.23	$1.24	$1.24	$1.24	$1.24	$1.24	$1.24	$1.34	$1.34	$1.74	$1.74		$1.34
NAS ALAMEDA FY 91 WATER PROCUREMENT														

Figure 13

NAS ALAMEDA FY 89 WATER SYSTEM PREVENTATIVE MAINTENANCE							
JON's 5154-	Description	Direct Labor Hours	Direct Labor (Dollars)	Direct Material (Dollars)	Other Direct Costs	Contracts (Dollars)	TOTALS (Dollars)
514	Service Water Distribution System	918	$13,341	$614	$0	$0	$13,954
604	PMI Water Distribution System	235	$3,139	$2,170	$0	$0	$5,309
606	DEIS	352	$4,858	$622	$0	$578	$6,058
TOTAL PREVENTATIVE		1,505	$21,338	$3,405	$0	$578	$25,321
Preventative Maint. % of Total Water Dist. Cost		5.46%	4.53%	0.56%	0.00%	0.12%	1.61%
NAS ALAMEDA FY 89 WATER SYSTEM REPAIRS							
512	Meter Maintenance	2	$30	$0	$0	$0	$30
513	Meter Reading	140	$1,863	$0	$0	$0	$1,863
520	Coating De-Alk Tank	34	$613	$0	$0	$0	$613
521	Work Pier 3-99-004	11	$180	$0	$0	$0	$180
600	Service & Maint. Water System	1,047	$23,097	$4,924	$0	$0	$28,022
614	Engineering Service	384	$6,015	$0	$0	$0	$6,015
618	Minors	12,089	$204,790	$130,295	$0	$0	$335,085
631	CUBIC	3,732	$41,222	$0	$0	$0	$41,222
641	Flush Hydrant	1	$13	$0	$0	$0	$13
645	Cathodic Protection	2	$24	$0	$0	$0	$24
654	Cathodic Protection Water Tank	2	$31	$0	$0	$0	$31
681	Clean & Paint Tanks	446	$8,920	$24,340	$0	$0	$33,260
TOTAL REPAIR		17,889	$286,799	$159,559	$0	$0	$446,358
Repair Maintenance % of Total Water Dist. Cost		64.95%	60.89%	26.28%	0.00%	0.00%	28.46%
NAS ALAMEDA FY 89 WATER SYSTEM CAPITAL IMPROVEMENTS							
601	Modify Pier 2-99-482	11	$142	$0	$0	$0	$142
642	Replace Water Dist. System Phase1	0	$0	$0	$0	$432,979	$432,979
676	Replace Water Dist. System Step 2	6,372	$127,435	$347,710	$0	$0	$475,145
678	Install Chlorinator	0	$0	$0	$2,700	$54,000	$56,700
682	Replace Water Distribution Pier	1,766	$35,325	$96,385	$0	$0	$131,710
TOTAL CAPITAL IMPROVE		8,149	$162,902	$444,095	$2,700	$486,979	$1,096,676
Capital Improvements % of Total Water Dist. Cost		29.59%	34.58%	73.16%	100.00%	99.88%	69.93%
TOTAL WATER DISTRIBUTION COSTS		27,543	$471,039	$607,059	$2,700	$487,557	$1,568,355
NAS ALAMEDA FY 89 WATER DISTRIBUTION COSTS							

Figure 14

NAS ALAMEDA FY 90 WATER SYSTEM PREVENTATIVE MAINTENANCE							
JON's 5154-	Description	Direct Labor Hours	Direct Labor (Dollars)	Direct Material (Dollars)	Other Direct Costs	Contracts (Dollars)	TOTALS (Dollars)
514	Service Water Distribution System	1,187	$17,170	$1,144	$0	$0	$18,314
604	PMI Water Distribution System	237	$3,535	$55	$0	$0	$3,590
606	DEIS	612	$8,833	$1,485	$0	$4,295	$14,612
TOTAL PREVENTATIVE		2,036	$29,538	$2,684	$0	$4,295	$36,517
Preventative Maint. % of Total Water Dist. Cost		17.91%	15.90%	4.46%	0.00%	2.97%	9.35%
NAS ALAMEDA FY 90 WATER SYSTEM REPAIRS							
200	Earthquake Damage	1,143	$18,963	$19,173	$0	$41,957	$80,093
513	Meter Reading	146	$1,983	$0	$0	$0	$1,983
600	Service & Maint. Water System	495	$10,335	$3,446	$0	$0	$13,782
614	Engineering Service	446	$8,654	$0	$0	$14,830	$23,484
618	Minors	6,702	$109,351	$31,545	$0	$0	$140,896
623	Fire Lines 99-015	10	$190	$0	$0	$0	$190
626	Fire Water Maint.	18	$333	$0	$0	$0	$333
631	CUBIC	164	$2,122	$0	$0	$0	$2,122
TOTAL REPAIR		9,122	$151,931	$54,165	$0	$56,787	$262,883
Repair Maintenance % of Total Water Dist. Cost		80.24%	81.79%	89.99%	0.00%	39.21%	67.28%
NAS ALAMEDA FY 90 WATER SYSTEM CAPITAL IMPROVEMENTS							
630	Replace Grates	179	$3,578	$3,339	$0	$0	$6,917
646	Replace Waterline	31	$701	$0	$0	$48,592	$49,293
676	Replace Water Dist. System Step 2	0	$0	$0	$0	$35,137	$35,137
TOTAL CAPITAL IMPROVE		210	$4,279	$3,339	$0	$83,730	$91,347
Capital Improvements % of Total Water Dist. Cost		1.85%	2.30%	5.55%	0.00%	57.82%	23.38%
TOTAL WATER DISTRIBUTION COSTS		11,368	$185,749	$60,188	$0	$144,811	$390,747
NAS ALAMEDA FY 90 WATER DISTRIBUTION COSTS							

Figure 15

JON's 5154-	Description	Direct Labor Hours	Direct Labor (Dollars)	Direct Material (Dollars)	Other Direct Costs	Contracts (Dollars)	TOTALS (Dollars)
NAS ALAMEDA FY 91 WATER SYSTEM PREVENTATIVE MAINTENANCE							
514	Service Water Distribution System	1,242	$19,331	$2,807	$0	$0	$22,138
604	PMI Water Distribution System	263	$4,028	$0	$0	$0	$4,028
606	DEIS	501	$7,967	$187	$0	$1,208	$9,361
TOTAL PREVENTATIVE		2,006	$31,326	$2,994	$0	$1,208	$35,527
Preventative Maint. % of Total Water Dist. Cost		16.96%	15.25%	2.83%	0.00%	0.24%	4.31%
NAS ALAMEDA FY 91 WATER SYSTEM REPAIRS							
500	Emergency Service	5	$119	$39	$0	$0	$158
512	Meter Maintenance	6	$152	$331	$0	$0	$483
513	Meter Reading	319	$5,219	$0	$0	$0	$5,219
600	Service & Maint. Water System	287	$6,832	$9,667	$0	$0	$16,500
614	Engineering Service	798	$16,756	$0	$0	$0	$16,756
618	Minors	7,328	$129,451	$92,390	$0	$0	$221,840
631	CUBIC	982	$13,688	$0	$0	$0	$13,688
661	General Repair	51	$1,015	$331	$0	$0	$1,346
681	Clean & Paint Tanks	43	$857	$175	$0	$0	$1,031
TOTAL REPAIR		9,818	$174,088	$102,933	$0	$0	$277,021
Repair Maintenance % of Total Water Dist. Cost		83.04%	84.75%	97.17%	0.00%	0.00%	33.61%
NAS ALAMEDA FY 91 WATER SYSTEM CAPITAL IMPROVEMENTS							
642	Replace Water Dist. System Phase1	0	$0	$0	$0	$508,752	$508,752
676	Replace Water Dist. System Step 2	0	$0	$0	$0	$2,853	$2,853
TOTAL CAPITAL IMPROVE		0	$0	$0	$0	$511,605	$511,605
Capital Improvements % of Total Water Dist. Cost		0.00%	0.00%	0.00%	0.00%	99.76%	62.08%
TOTAL WATER SYSTEM DISTRIBUTION COSTS		11,823	$205,414	$105,926	$0	$512,813	$824,153

NAS ALAMEDA FY 91 WATER DISTRIBUTION COSTS

Figure 16

CHARGES	Jul-88	Aug-88	Sep-88	Oct-88	Nov-88	Dec-88	Jan-89	Feb-89	Mar-89	Apr-89	May-89	Jun-89
Customer Charge ($)	100	100	100	100	100	100	100	100	100	100	100	100
Demand Charge ($)	39,485	39,010	41,645	42,422	40,003	40,196	41,518	42,578	42,440	42,378	42,117	39,352
Demand Summer Peak ($)	171,978	169,344	175,177	184,773	0	0	0	0	0	18,621	181,191	169,297
Energy Summer Peak ($)	121,090	125,851	116,558	133,044	0	0	0	0	0	9,097	91,660	86,678
Energy Summer Part-Pk($)	120,320	125,779	121,891	136,106	0	0	0	0	0	10,228	92,261	86,680
Energy Summer Off-Pk ($)	119,607	104,413	108,125	121,534	0	0	0	0	0	2,016	29,064	29,697
Energy Winter Part-Pk ($)	0	0	0	0	242,444	209,111	146,989	167,769	173,738	154,382	0	0
Energy Winter Off-Peak ($)	0	0	0	0	104,487	94,437	12,482	14,362	15,546	13,128	0	0
ENERGY SUBTOTAL ($) x MULTI. FACTOR (.8025)	459,496	453,008	452,205	495,929	310,595	275,935	161,374	180,409	186,039	200,584	350,205	330,473
Adj. Summer Peak ($)	62,753	65,220	60,404	68,948	0	0	0	0	0	10,321	103,993	98,341
Adj. Summer Partial-Pk ($)	61,573	64,367	62,377	69,652	0	0	0	0	0	11,860	106,982	100,510
Adj. Summer Off-Peak ($)	140,060	122,268	126,615	142,316	0	0	0	0	0	15,568	224,419	229,309
Adj. Winter Partial-Peak ($)	0	0	0	0	132,928	129,344	198,914	227,035	235,113	208,918	0	0
Adj. Winter Off-Peak ($)	0	0	0	0	144,825	158,528	201,208	231,507	250,601	211,611	0	0
Surcharge ($)	2,347	2,222	2,208	2,486	2,381	2,280	2,002	2,294	2,434	2,299	2,275	2,242
TOTAL BILLINGS ($)	726,229	707,084	703,809	779,331	590,728	566,087	563,498	641,246	674,187	661,162	787,874	760,874

TOTAL YEARLY COST: Demand $1,254,729; Energy Charge $2,600,560; Adjustment Chg. $4,278,389; Total Billing $8,162,111

USAGE	Jul-88	Aug-88	Sep-88	Oct-88	Nov-88	Dec-88	Jan-89	Feb-89	Mar-89	Apr-89	May-89	Jun-89
Demand (KW)	21,936	21,672	23,136	23,568	22,224	22,152	21,624	22,176	22,104	22,104	21,936	20,496
Energy Peak (MWH)	2,523	2,622	2,429	2,772	0	0	0	0	0	977	2,548	2,410
Energy Partial-Peak(MWH)	2,594	2,711	2,628	2,934	5,345	4,788	4,674	5,334	5,524	4,909	2,696	2,533
Energy Off-Peak (MWH)	6,619	5,778	5,984	6,726	6,559	6,612	5,334	6,138	6,644	5,610	6,132	6,265
TOTAL USAGE (MWH)	11,736	11,112	11,040	12,432	11,904	11,400	10,008	11,472	12,168	11,496	11,376	11,208
MONTHLY UNIT COST- $/MWH	$61.88	$63.63	$63.75	$62.69	$49.62	$49.66	$56.30	$55.90	$55.41	$57.51	$69.26	$67.89

AVERAGE UNIT COST ($ / MWH): TOTAL BILLINGS ($8,162,111) ÷ TOTAL USAGE (137,352) = $59.42 /MWH

SITE 1 FY 89 ELECTRICAL PROCUREMENT

Figure 17

CHARGES	Jul-89	Aug-89	Sep-89	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90
Customer Charge ($)	100	100	100	100	100	112	220	220	220	220	220	220
Demand Charge ($)	40,550	41,288	44,790	48,186	42,624	44,181	56,098	56,659	56,722	56,734	58,843	57,158
Demand Summer Peak ($)	174,451	177,623	192,689	207,299	0	0	0	0	0	19,430	199,162	177,514
Energy Summer Peak ($)	90,266	90,732	94,814	91,735	0	0	0	0	0	9,696	78,732	77,665
Energy Summer Part-Pk($)	89,743	90,880	95,785	92,668	0	0	0	0	0	5,668	44,334	41,259
Energy Summer Off-Pk ($)	29,255	28,126	33,735	32,638	0	0	0	0	0	2,599	39,535	33,238
Energy Winter Part-Pk ($)	0	0	0	0	179,685	137,606	70,196	18,821	17,838	17,452	0	0
Energy Winter Off-Peak ($)	0	0	0	0	17,294	22,225	85,687	46,328	39,056	38,296	0	0
ENERGY SUBTOTAL ($) x MULTI. FACTOR (.8025)	340,554	344,071	370,685	379,282	192,362	163,810	170,290	97,928	91,352	120,452	337,713	310,611
Adj. Summer Peak ($)	102,412	102,940	107,572	104,078	0	0	0	0	0	19,482	158,194	156,051
Adj. Summer Partial-Pk ($)	104,062	105,381	111,068	107,454	0	0	0	0	0	16,511	129,140	120,183
Adj. Summer Off-Peak ($)	225,895	217,177	260,482	252,015	0	0	0	0	0	20,379	309,970	260,600
Adj. Winter Partial-Peak ($)	0	0	0	0	243,160	197,157	213,807	290,880	275,679	269,715	0	0
Adj. Winter Off-Peak ($)	0	0	0	0	278,776	230,256	193,910	297,823	251,071	246,186	0	0
Surcharge ($)	2,261	2,222	2,510	2,429	2,621	2,160	2,150	2,506	2,227	2,400	2,400	2,136
TOTAL BILLINGS ($)	775,183	771,792	852,317	845,259	716,918	593,382	580,158	689,137	620,330	695,124	937,416	849,581
TOTAL YEARLY COST:	Demand $1,405,981;				Energy Charge $1,511,578;			Adjustment Chg. $5,979,465;			Total Billing $8,926,597	
USAGE	Jul-89	Aug-89	Sep-89	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90
Demand (KW)	21,120	21,504	23,328	25,097	22,200	22,224	21,576	21,792	21,816	22,080	22,632	21,984
Energy Peak (MWH)	2,509	2,522	2,636	2,550	0	0	0	0	0	1,092	2,436	2,403
Energy Partial-Peak(MWH)	2,623	2,656	2,799	2,708	5,713	4,633	5,032	5,487	5,201	5,088	2,628	2,446
Energy Off-Peak (MWH)	6,172	5,934	7,117	6,886	7,391	6,167	5,720	7,041	5,935	5,820	6,936	5,831
TOTAL USAGE (MWH)	11,304	11,112	12,552	12,144	13,104	10,800	10,752	12,528	11,136	12,000	12,000	10,680
MONTHLY UNIT COST-$/MWH	$68.58	$69.46	$67.90	$69.60	$54.71	$54.94	$53.96	$55.01	$55.70	$57.93	$78.12	$79.55
AVERAGE UNIT COST ($ / MWH):			TOTAL BILLINGS ($8,926,597) ÷ TOTAL USAGE (140,112) = $63.71 / MWH									
SITE 1 FY 90 ELECTRICAL PROCUREMENT												

Figure 18

CHARGES	Jul-90	Aug-90	Sep-90	Oct-90	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91
Customer Charge ($)	220	220	220	220	220	220	220	220	220	220	220	220
Demand Charge ($)	54,600	57,034	57,595	57,845	56,410	54,369	56,295	59,405	57,792	58,889	66,067	62,645
Demand Summer Peak ($)	184,800	193,037	194,938	195,782	0	0		0	0	21,395	216,720	212,184
Energy Summer Peak ($)	80,322	84,949	76,613	88,846	0	0		0	0	7,383	62,050	60,783
Energy Summer Part-Pk($)	44,618	46,462	42,729	49,803	0	0		0	0	3,465	26,922	25,846
Energy Summer Off-Pk ($)	35,739	41,003	33,748	35,630	0	0		0	0	(286)	(4,612)	(3,610)
Energy Winter Part-Pk ($)	0	0	0	0	17,979	13,269	(3,311)	(7,646)	(7,457)	(7,002)	0	0
Energy Winter Off-Peak ($)	0	0	0	0	48,418	36,135	9,964	12,273	9,980	9,676	0	0
ENERGY SUBTOTAL ($) x MULTI. FACTOR (.8025)	321,239	339,221	325,689	343,571	98,729	83,454	50,692	51,562	48,579	75,225	294,812	287,349
Adj. Summer Peak ($)	161,389	170,687	153,937	178,517	0	0	0	0	0	20,726	174,187	170,631
Adj. Summer Partial-Pk ($)	129,965	135,339	124,463	145,068	0	0	0	0	0	18,667	145,038	139,242
Adj. Summer Off-Peak ($)	280,206	321,476	264,597	279,353	0	0	0	0	0	21,260	342,258	267,912
Adj. Winter Partial-Peak ($)	0	0	0	0	277,857	254,612	268,053	319,619	311,736	292,711	0	0
Adj. Winter Off-Peak ($)	0	0	0	0	311,260	261,547	280,845	345,908	281,303	272,718	0	0
Surcharge ($)	2,280	2,515	2,165	2,390	2,520	2,150	1,992	2,419	2,136	2,242	2,275	1,963
TOTAL BILLINGS ($)	895,080	969,238	870,851	948,900	690,366	601,764	601,583	719,508	643,754	703,549	958,570	867,098

TOTAL YEARLY COST: Demand $1,539,035; Energy Charge $778,970; Adjustment Chg. $7,123,090; Total Billing $9,470,261

USAGE	Jul-90	Aug-90	Sep-90	Oct-90	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91
Demand (KW)	21,000	21,936	22,152	22,248	21,696	20,712	20,105	21,216	20,640	20,424	21,312	20,208
Energy Peak (MWH)	2,485	2,628	2,370	2,749	0	0	0	0	0	1,009	2,355	2,307
Energy Partial-Peak(MWH)	2,645	2,754	2,533	2,952	5,242	4,709	4,362	5,201	5,073	4,763	2,525	2,425
Energy Off-Peak (MWH)	6,270	7,193	5,921	6,251	7,358	6,043	5,598	6,895	5,607	5,436	6,496	5,085
TOTAL USAGE (MWH)	11,400	12,576	10,824	11,952	12,600	10,752	9,960	12,096	10,680	11,208	11,376	9,816
MONTHLY UNIT COST- $/MWH	$78.52	$77.07	$80.46	$79.39	$54.79	$55.97	$60.40	$59.48	$60.28	$62.77	$84.26	$88.34

AVERAGE UNIT COST ($ / MWH): TOTAL BILLINGS ($9,470,261) ÷ TOTAL USAGE (135,240) = $70.03 / MWH

SITE 1 FY 91 ELECTRICAL PROCUREMENT

Figure 19

SITE 1 FY 90 ELECTRICAL SYSTEM PREVENTATIVE MAINTENANCE			
Account Description	Direct Labor (Dollars)	Direct Materials (Dollars)	TOTALS (Dollars)
Transformer Preventative Maint.	$6,977	$1,567	$8,543
Underground Electrical System Preventative Maintenance	$1,365	$307	$1,672
TOTAL PREVENTATIVE	$8,342	$1,873	$10,215
Preventative Maintenance % of Total Electrical Distribution Cost	3.03%	3.03%	3.03%
SITE 1 FY 90 ELECTRICAL SYSTEM REPAIRS			
Electric Distribution Substation Maint.	$67,715	$15,205	$82,919
Transformer Maintenance	$8,917	$2,002	$10,919
High Voltage Switch Maintenance	$4,325	$971	$5,297
Underground Electrical System Maint.	$15,377	$3,453	$18,830
Electrical Manhole Maintenance	$30,997	$6,960	$37,957
Street Lighting Maintenance	$85,759	$19,256	$105,015
Other Lighting Maintenance	$6,435	$1,445	$7,880
Miscellaneous Engineering Design	$46,982	$10,549	$57,532
TOTAL REPAIR	$266,508	$59,841	$326,350
Repair Maintenance % of Total Electrical Distribution Cost	96.97%	96.97%	96.97%
SITE 1 FY 90 ELECTRICAL SYSTEM CAPITAL IMPROVEMENTS			
NO REPLACEMENTS IN FY 90	$0	$0	$0
TOTAL CAPITAL IMPROVEMENT	$0	$0	$0
Capital Improvements % of Total Electrical Distribution Cost	0.00%	0.00%	0.00%
TOTAL ELECTRICAL DISTRIBUTION COSTS	$274,850	$61,714	$336,564
SITE 1 FY 90 ELECTRICAL DISTRIBUTION COSTS			

Figure 20

SITE 1 FY 91 ELECTRICAL SYSTEM PREVENTATIVE MAINTENANCE			
Account Description	Direct Labor (Dollars)	Direct Materials (Dollars)	TOTALS (Dollars)
Underground Electrical System Preventative Maintenance	$350	$85	$435
TOTAL PREVENTATIVE	$350	$85	$435
Preventative Maintenance % of Total Electrical Distribution Cost	0.18%	0.18%	0.18%
SITE 1 FY 91 ELECTRICAL SYSTEM REPAIRS			
Electric Distribution Substation Maint.	$22,702	$5,526	$28,227
Transformer Maintenance	$8,614	$2,097	$10,711
High Voltage Switch Maintenance	$10,207	$2,485	$12,692
Underground Electrical System Maint.	$4,344	$1,057	$5,401
Electrical Manhole Maintenance	$13,649	$3,322	$16,971
Street Lighting Maintenance	$46,442	$11,304	$57,746
Other Lighting Maintenance	$4,567	$1,112	$5,679
Miscellaneous Engineering Design	$82,109	$19,986	$102,095
TOTAL REPAIR	$192,633	$46,888	$239,522
Repair Maintenance % of Total Electrical Distribution Cost	99.82%	99.82%	99.82%
SITE 1 FY 91 ELECTRICAL SYSTEM CAPITAL IMPROVEMENTS			
NO REPLACEMENTS IN FY 91	$0	$0	$0
TOTAL CAPITAL IMPROVEMENT	$0	$0	$0
Capital Improvements % of Total Electrical Distribution Cost	0.00%	0.00%	0.00%
TOTAL ELECTRICAL DISTRIBUTION COSTS	$192,983	$46,974	$239,957
SITE 1 FY 91 ELECTRICAL DISTRIBUTION COSTS			

Figure 21

SITE 1 FY 92 ELECTRICAL SYSTEM PREVENTATIVE MAINTENANCE			
Account Description	Direct Labor (Dollars)	Direct Materials (Dollars)	TOTALS (Dollars)
Electrical Distribution Substation Preventative Maintenance	$243	$205	$448
Transformer Preventative Maint.	$84	$71	$156
High Voltage Switch: Oil / Dry Preventative Maintenance	$63	$54	$117
TOTAL PREVENTATIVE	$391	$330	$721
Preventative Maintenance % of Total Electrical Distribution Cost	0.20%	0.20%	0.20%
SITE 1 FY 92 ELECTRICAL SYSTEM REPAIRS			
Electric Distribution Substation Maint.	$69,156	$58,463	$127,619
Transformer Maintenance	$6,462	$5,463	$11,925
High Voltage Switch Maintenance	$5,312	$4,491	$9,803
Underground Electrical System Maint.	$9,044	$7,645	$16,689
Electrical Manhole Maintenance	$5,819	$4,919	$10,738
Street Lighting Maintenance	$29,520	$24,956	$54,476
Other Lighting Maintenance	$1,780	$1,505	$3,285
Miscellaneous Engineering Design	$65,446	$55,327	$120,774
TOTAL REPAIR	$192,540	$162,770	$355,310
Repair Maintenance % of Total Electrical Distribution Cost	99.26%	99.26%	99.26%
SITE 1 FY 92 ELECTRICAL SYSTEM CAPITAL IMPROVEMENTS			
High Voltage Switches: Replacement	$1,043	$882	$1,925
TOTAL CAPITAL IMPROVEMENT	$1,043	$882	$1,925
Capital Improvements % of Total Electrical Distribution Cost	0.54%	0.54%	0.54%
TOTAL ELECTRICAL DISTRIBUTION COSTS	$193,973	$163,982	$357,956
SITE 1 FY 92 ELECTRICAL DISTRIBUTION COSTS			

Figure 22

CHARGES	Jul-89	Aug-89	Sep-89	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	TOTALS	Avg/Month
Meter Charge	954	568	871	1,913	1,925	923	1,068	1,791	1,304	1,296	1,860	1,324	15,798	1,316
Base Flow Charge	31,648	23,734	31,763	106,777	80,018	45,128	33,801	52,661	37,074	29,843	57,789	44,577	574,813	47,901
1st Penalty Charge	236	558	1,025	0	0	0	0	0	0	0	0	0	1,818	152
2nd Penalty Charge	90	744	1,366	0	0	0	0	0	0	0	0	0	2,200	183
3rd Penalty Charge	(2)	4,075	(5,265)	(5,330)	0	0	0	0	0	0	0	0	(6,523)	(544)
Elevation Charge	4,810	3,885	5,107	16,989	13,633	8,453	5,620	9,195	6,164	4,961	9,607	7,411	95,835	7,986
Total Billings ($)	37,736	33,564	34,866	120,348	95,576	54,504	40,489	63,647	44,542	36,100	69,257	53,312	683,941	56,995

USAGE	Jul-89	Aug-89	Sep-89	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	TOTALS	Avg/Month
Monthly Usage (Thousand/Gal)	27,052	21,847	28,724	95,544	76,671	47,543	31,606	51,714	34,665	27,903	54,033	41,679	538,980	44,915
Avg Daily Demand (Thousand/Gal) (30 Day Month)	902	728	957	3,185	2,556	1,585	1,054	1,724	1,155	930	1,801	1,389		
MONTHLY UNIT COST ($/Thousand/Gal)	$1.39	$1.54	$1.21	$1.26	$1.25	$1.15	$1.28	$1.23	$1.28	$1.29	$1.28	$1.28		$1.27

SITE 1 FY 90 WATER PROCUREMENT

Figure 23

CHARGES	Jul-90	Aug-90	Sep-90	Oct-90	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	TOTALS	Avg/Month
Meter Charge	1,333	1,510	1,219	1,209	1,219	2,422	1,519	1,510	1,519	1,510	1,519	1,510	17,998	1,500
Base Flow Charge	50,382	55,308	51,473	48,618	50,215	74,119	39,252	39,955	45,814	38,460	42,881	48,335	584,812	48,734
1st Penalty Charge	4,616	4,455	4,148	3,916	4,043	5,970	3,163	3,220	3,693	3,096	3,456	3,578	47,355	3,946
2nd Penalty Charge	49	49	49	49	49	49	49	49	49	49	49	49	591	49
3rd Penalty Charge	4,283	4,133	3,848	3,633	3,751	5,539	2,934	2,987	3,426	2,873	3,206	3,321	43,933	3,661
Elevation Charge	8,376	8,509	7,919	7,480	7,725	11,403	6,039	6,147	7,048	5,917	6,597	6,835	89,995	7,500
Total Billings ($)	69,039	73,964	68,655	64,904	67,003	99,503	52,956	53,867	61,550	51,905	57,709	63,628	784,684	65,390
USAGE	Jul-90	Aug-90	Sep-90	Oct-90	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	TOTALS	Avg/Month
Monthly Usage (Thousand/Gal)	47,108	45,462	42,310	39,963	41,275	60,924	32,264	32,842	37,658	31,613	35,247	36,520	483,186	40,266
Avg Daily Demand (Thousand/Gal) (30 Day Month)	1,570	1,515	1,410	1,332	1,376	2,031	1,075	1,095	1,255	1,054	1,175	1,217		
MONTHLY UNIT COST ($/Thousand/Gal)	$1.47	$1.63	$1.62	$1.62	$1.62	$1.63	$1.64	$1.64	$1.63	$1.64	$1.64	$1.74		$1.62
SITE 1 FY 91 WATER PROCUREMENT														

Figure 24

SITE 1 FY 90 WATER SYSTEM PREVENTATIVE MAINTENANCE			
Account Description	Direct Labor (Dollars)	Direct Materials (Dollars)	TOTALS (Dollars)
Fire Hydrant Preventative Maintenance	$1,069	$866	$1,935
TOTAL PREVENTATIVE	$1,069	$866	$1,935
Preventative Maintenance % of Total Water Distribution Cost	0.64%	0.64%	0.64%
SITE 1 FY 90 WATER SYSTEM REPAIRS			
Water Distribution System Maintenance	$113,166	$91,672	$204,838
Water Meter Maintenance	$8,733	$7,074	$15,807
Fire Hydrant Maintenance	$24,820	$20,106	$44,926
Backflow Device Maintenance	$1,648	$1,335	$2,983
Water Valve (Check,Gates,Globe) Maintenance	$9,828	$7,961	$17,790
Pressure Reducing Valve Maintenance	$6,979	$5,653	$12,632
Miscellaneous Gauges, Valves, Absorbers, Pump Shaft, Maintenance	$278	$226	$504
TOTAL REPAIR	$165,452	$134,028	$299,479
Repair Maintenance % of Total Water Distribution Cost	98.64%	98.64%	98.64%
SITE 1 FY 90 WATER SYSTEM CAPITAL IMPROVEMENTS			
Water Meter Replacement	$1,207	$978	$2,184
TOTAL CAPITAL IMPROVEMENT	$1,207	$978	$2,184
Capital Improvements % of Total Water Distribution Cost	0.72%	0.72%	0.72%
TOTAL WATER DISTRIBUTION COSTS	$167,728	$135,871	$303,599
SITE 1 FY 90 WATER DISTRIBUTION COSTS			

Figure 25

SITE 1 FY 91 WATER SYSTEM PREVENTATIVE MAINTENANCE			
Account Description	Direct Labor (Dollars)	Direct Materials (Dollars)	TOTALS (Dollars)
No Preventative Maintenance In FY 91	$0	$0	$0
TOTAL PREVENTATIVE	$0	$0	$0
Preventative Maintenance % of Total Water Distribution Cost	0.00%	0.00%	0.00%
SITE 1 FY 91 WATER SYSTEM REPAIRS			
Water Distribution System Maintenance	$116,565	$17,864	$134,429
Water Meter Maintenance	$7,751	$1,188	$8,939
Fire Hydrant Maintenance	$16,409	$2,515	$18,924
Backflow Device Maintenance	$3,292	$504	$3,796
Water Valve (Check,Gates,Globe) Maintenance	$3,077	$472	$3,548
Pressure Reducing Valve Maintenance	$1,951	$299	$2,250
Miscellaneous Gauges, Valves, Absorbers, Pump Shaft, Maintenance	$345	$53	$398
TOTAL REPAIR	$149,389	$22,895	$172,284
Repair Maintenance % of Total Water Distribution Cost	97.90%	97.90%	97.90%
SITE 1 FY 91 WATER SYSTEM CAPITAL IMPROVEMENTS			
Water Meter Replacement	$3,197	$490	$3,687
TOTAL CAPITAL IMPROVEMENT	$3,197	$490	$3,687
Capital Improvements % of Total Water Distribution Cost	2.10%	2.10%	2.10%
TOTAL WATER DISTRIBUTION COSTS	$152,586	$23,385	$175,971
SITE 1 FY 91 WATER DISTRIBUTION COSTS			

Figure 26

SITE 1 FY 92 WATER SYSTEM PREVENTATIVE MAINTENANCE			
Account Description	Direct Labor (Dollars)	Direct Materials (Dollars)	TOTALS (Dollars)
No Preventative Maintenance In FY 92	$0	$0	$0
TOTAL PREVENTATIVE	$0	$0	$0
Preventative Maintenance % of Total Water Distribution Cost	0.00%	0.00%	0.00%
SITE 1 FY 92 WATER SYSTEM REPAIRS			
Water Distribution System Maintenance	$108,672	$37,473	$146,145
Water Meter Maintenance	$7,233	$2,494	$9,727
Fire Hydrant Maintenance	$1,134	$391	$1,525
Backflow Device Maintenance	$7,377	$2,544	$9,921
Pressure Reducing Valve Maintenance	$408	$141	$549
Miscellaneous Gauges, Valves, Absorbers, Pump Shaft, Maintenance	$2,841	$980	$3,821
TOTAL REPAIR	$127,664	$44,022	$171,687
Repair Maintenance % of Total Water Distribution Cost	99.44%	99.44%	99.44%
SITE 1 FY 92 WATER SYSTEM CAPITAL IMPROVEMENTS			
Water Meter Replacement	$718	$248	$966
TOTAL CAPITAL IMPROVEMENT	$718	$248	$966
Capital Improvements % of Total Water Distribution Cost	0.56%	0.56%	0.56%
TOTAL WATER DISTRIBUTION COSTS	$128,383	$44,270	$172,652
SITE 1 FY 92 WATER DISTRIBUTION COSTS			

Figure 27

CHARGES	Sep-89	Oct-89	Nov-89	Dec-90	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90
Electricity Charges ($)	736,447	681,945	895,020	600,131	580,783	620,090	546,554	590,592	578,424	830,122	700,346	678,708
TOTAL YEARLY COST:	TOTAL BILLING - $8,039,162					AVERAGE MONTHLY COST - $699,930						
USAGE	Sep-89	Oct-89	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90
Total Energy Demand (MWH)	12,108	12,216	13,313	12,400	12,031	12,742	11,658	12,822	12,576	13,407	13,133	12,320
Average Daily Demand (MWH/30 Day Month)	405	407	401	413	401	429	389	407	400	447	438	411
MONTHLY UNIT COST ($/MWH)	$60.63	$55.82	$67.23	$48.40	$48.27	$46.88	$46.88	$46.06	$45.99	$61.92	$53.33	$55.09
AVERAGE UNIT COST ($/MWH):	TOTAL BILLING ($8,039,162) ÷ TOTAL ENERGY DEMAND (150,767) = $53.32 / MWH											

SITE 2 FY 90 ELECTRICAL PROCUREMENT

CHARGES	Sep-89	Oct-89	Nov-89	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-90	Jul-91	Aug-91
Electricity Charges ($)	719,916	656,296	793,443	580,732	538,182	691,961	545,531	605,844	684,548	719,857	739,929	739,346
TOTAL YEARLY COST:	TOTAL BILLING - $8,015,585					AVERAGE MONTHLY COST - $667,965						
USAGE	Sep-90	Oct-89	Nov-90	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-90	Jun-91	Jul-91	Aug-91
Total Energy Demand (MWH)	12,576	12,108	13,573	12,595	11,989	13,446	12,069	13,062	11,989	12,796	12,241	12,487
Average Daily Demand (MWH/30 Day Month)	429	400	452	420	400	448	418	405	400	427	408	416
MONTHLY UNIT COST ($/MWH)	$55.91	$54.21	$58.46	$46.11	$44.89	$51.46	$45.20	$46.88	$57.10	$56.25	$60.44	$59.21
AVERAGE UNIT COST ($/MWH):	TOTAL BILLING ($8,015,585) ÷ TOTAL ENERGY DEMAND (151,230) = $53.00 / MWH											

SITE 2 FY 91 ELECTRICAL PROCUREMENT

Figure 28

CHARGES	Sep-89	Oct-89	Nov-89	Dec-90	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90
Water Charges ($)	198,382	188,314	186,833	177,213	172,464	182,758	202,463	202,913	215,856	213,779	267,986	274,691
TOTAL YEARLY COST:	TOTAL BILLING $2,483,652							AVERAGE MONTHLY COST $206,971				
USAGE	Sep-90	Oct-90	Nov-89	Dec-89	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90
Total Usage (Thousand/Gallons)	104,853	86,621	83,819	66,372	57,719	47,830	83,421	84,512	107,231	103,525	108,059	103,657
Average Daily Demand (Thousand Gal/30 Day Month	3,495	2,887	2,794	2,212	1,924	1,594	2,781	2,817	3,574	3,451	3,602	3,455
MONTHLY UNIT COST ($/Thousand/Gallons)	$1.89	$2.17	$2.23	$2.67	$2.99	$[illegible].82	$2.43	$2.40	$2.01	$2.06	$2.48	$2.65
AVERAGE UNIT COST ($/THOUSAND/GALLONS):	TOTAL BILLING ($2,483,652) ÷ TOTAL USAGE (1,037,619) = $2.39 / Thousand/Gal.											

SITE 2 FY 90 WATER PROCUREMENT

CHARGES	Sep-89	Oct-90	Nov-89	Dec-90	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	Jul-91	Aug-91
Water Charges ($)	75,319	246,197	159,078	59,390	53,041	55,250	52,872	45,952	59,740	58,031	79,276	79,367
TOTAL YEARLY COST:	TOTAL BILLING $1,023,513							AVERAGE MONTHLY COST $85,293				
USAGE	Sep-90	Oct-90	Nov-89	Dec-89	Jan-91	Feb-91	Mar-91	Apr-91	May-90	Jun-91	Jul-91	Aug-91
Total Usage (Thousand/Gallons)	98,536	103,989	81,747	65,744	60,088	61,731	59,800	55,708	68,586	73,826	72,252	86,788
Average Daily Demand (Thousand Gal/30 Day Month	3,285	3,466	2,725	2,191	2,003	2,058	1,993	1,857	2,286	2,461	2,46[illegible]	2,893
MONTHLY UNIT COST ($/Thousand/Gallons)	$0.76	$2.37	$1.95	$0.90	$0.88	$0.90	$0.88	$0.82	$2.67	$0.79	$1.10	$0.91
AVERAGE UNIT COST ($/THOUSAND/GALLONS):	TOTAL BILLING ($1,023,513) ÷ TOTAL USAGE (888,795) = $1.15 / Thousand/Gal.											

SITE 2 FY 91 WATER PROCUREMENT

Figure 29

CHARGES	Jan-89	Feb-89	Mar-89	Apr-89	May-89	Jun-89	Jul-89	Aug-89	Sep-89	Oct-89	Nov-89	Dec-89
Schedule E20P Charge ($)	18,908	21,563	20,523	27,320	36,233	40,918	38,301	41,145	36,738	32,244	21,708	23,103
Power Factor Adjustment ($)	45	52	62	98	130	147	161	198	198	193	130	111
Energy Commission Tax ($)	66	77	69	88	97	107	99	117	95	85	77	80
City Tax ($)	1,422	1,621	1,544	2,056	2,727	3,080	2,885	3,101	2,770	2,433	1,638	1,741
TOTAL BILLINGS ($)	20,441	23,313	22,198	29,562	39,187	44,252	41,445	44,560	39,802	34,956	23,553	25,035

TOTAL YEARLY COST: Schedule E20P $358,704; Power Factor Adj. $1,526; City Tax $27,017; TOTAL BILLING $388,304

USAGE	Jan-89	Feb-89	Mar-89	Apr-89	May-89	Jun-89	Jul-89	Aug-89	Sep-89	Oct-89	Nov-89	Dec-89
Winter Partial-Peak (KWH)	130,800	140,400	142,800	156,000	0	0	0	0	0	19,200	141,600	156,000
Winter Off-Peak (KWH)	196,800	243,600	204,000	217,200	0	0	0	0	0	14,400	244,800	244,800
Summer Peak (KWH)	0	0	0	16,800	91,200	116,400	110,400	121,200	100,800	76,800	0	0
Summer Partial-Peak (KWH)	0	0	0	19,200	88,800	112,800	102,000	112,800	100,800	81,600	0	0
Summer Off-Peak (KWH)	0	0	0	30,000	303,600	303,600	282,000	350,400	273,600	235,200	0	0
Total Energy Demand (MWH)	328	384	347	439	484	533	494	584	475	427	386	401
MONTHLY UNIT COST ($/MWH)	$62.40	$60.71	$64.01	$67.31	$81.03	$83.06	$83.83	$76.25	$83.76	$81.83	$60.96	$62.46

AVERAGE UNIT COST ($/MWH): TOTAL BILLING ($388,304) ÷ TOTAL ENERGY DEMAND (5,282) = $73.51 / MWH

SITE 3 FY 89 ELECTRICAL PROCUREMENT

Figure 30

CHARGES	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90	Sep-90	Oct-90	Nov-90	Dec-90
Schedule E20P Charge ($)	22,822	22,037	21,583	28,646	40,215	49,114	42,715	44,650	39,783	34,142	23,510	24,805
Power Factor Adjustment ($)	123	119	130	172	458	0	205	241	239	225	155	134
Energy Commission Tax ($)	77	73	72	87	91	113	92	96	85	74	80	82
City Tax ($)	1,721	1,662	1,628	2,161	3,051	3,684	3,219	3,367	3,002	2,578	1,775	1,870
TOTAL BILLINGS ($)	24,742	23,891	23,413	31,066	43,816	52,910	46,231	48,353	43,108	37,019	25,520	26,891
TOTAL YEARLY COST:	Schedule E20P $394,020;			Power Factor Adj. $2,201;				City Tax $29,717;		TOTAL BILLING $426,958		
USAGE	Jan-90	Feb-90	Mar-90	Apr-90	May-90	Jun-90	Jul-90	Aug-90	Sep-90	Oct-90	Nov-90	Dec-90
Winter Partial-Peak (KWH)	148,800	142,800	147,600	144,000	0	0	0	0	0	7,200	142,800	158,400
Winter Off-Peak (KWH)	234,000	224,400	210,000	202,800	0	0	0	0	0	9,600	256,800	250,800
Summer Peak (KWH)	0	0	0	16,800	86,400	106,800	96,000	103,200	87,600	72,000	0	0
Summer Partial-Peak (KWH)	0	0	0	15,600	92,400	112,800	99,600	100,800	87,600	73,200	0	0
Summer Off-Peak (KWH)	0	0	0	54,000	277,200	343,200	262,800	273,600	248,400	208,800	0	0
Total Energy Demand (MWH)	383	367	358	433	456	563	458	478	424	371	400	409
MONTHLY UNIT COST ($/MWH)	$64.63	$65.06	$65.47	$71.71	$96.09	$94.01	$100.85	$101.24	$101.76	$99.83	$63.86	$65.72
AVERAGE UNIT COST ($/MWH):	TOTAL BILLING ($426,958) ÷ TOTAL ENERGY DEMAND (5,099) = $83.74 / MWH											
SITE 3 FY 90 ELECTRICAL PROCUREMENT												

Figure 31

CHARGES	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	Jul-91	Aug-91	Sep-91	Oct-91	Nov-91	Dec-91
Schedule E20P Charge ($)	24,693	23,003	27,191	28,535	41,950	46,859	46,886	47,995	43,118	35,021	23,256	25,973
Power Factor Adjustment ($)	133	152	163	188	252	253	225	230	259	210	140	140
Energy Commission Tax ($)	76	70	83	79	87	99	105	104	98	78	78	87
City Tax ($)	1,862	1,737	2,052	2,154	3,165	3,533	3,533	3,617	3,253	2,642	1,755	1,958
TOTAL BILLINGS ($)	26,764	24,961	29,488	30,957	45,454	50,744	50,749	51,947	46,727	37,951	25,228	28,159
TOTAL YEARLY COST:	Schedule E20P $414,479;			Power Factor Adj. $2,345;				City Tax $31,262;			TOTAL BILLING $449,129	
USAGE	Jan-91	Feb-91	Mar-91	Apr-91	May-91	Jun-91	Jul-91	Aug-91	Sep-91	Oct-91	Nov-91	Dec-91
Winter Partial-Peak (KWH)	142,800	134,400	166,800	124,800	0	0	0	0	0	14,400	147,600	163,200
Winter Off-Peak (KWH)	235,200	214,800	247,200	177,600	0	0	0	0	0	42,000	243,600	273,600
Summer Peak (KWH)	0	0	0	14,400	80,400	100,800	100,800	108,000	88,800	72,000	0	0
Summer Partial-Peak (KWH)	0	0	0	16,800	87,600	99,600	104,400	108,000	98,400	73,200	0	0
Summer Off-Peak (KWH)	0	0	0	60,000	266,400	292,800	318,000	303,600	301,200	188,400	0	0
Total Energy Demand (MWH)	378	349	414	394	434	493	523	520	488	390	391	437
MONTHLY UNIT COST ($/MWH)	$70.80	$71.48	$71.23	$78.65	$104.64	$102.89	$97.00	$99.97	$95.67	$97.31	$64.49	$64.47
AVERAGE UNIT COST ($/MWH):	TOTAL BILLING ($449,129) ÷ TOTAL ENERGY DEMAND (5,212) = $86.18 / MWH											
SITE 3 FY 91 ELECTRICAL PROCUREMENT												

Figure 32

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   Naval Postgraduate School
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7. Professor Douglas Moses, Code AS/MO — 1
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   Naval Postgraduate School
   Monterey, California 93943-5002

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c.1 Utilities cost comparison analysis between a public work center and the non-DoD sector.